

JULY 1955

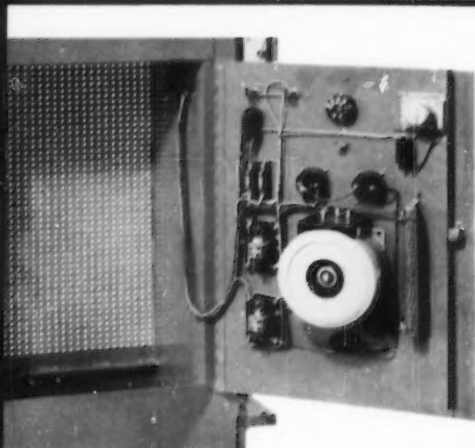
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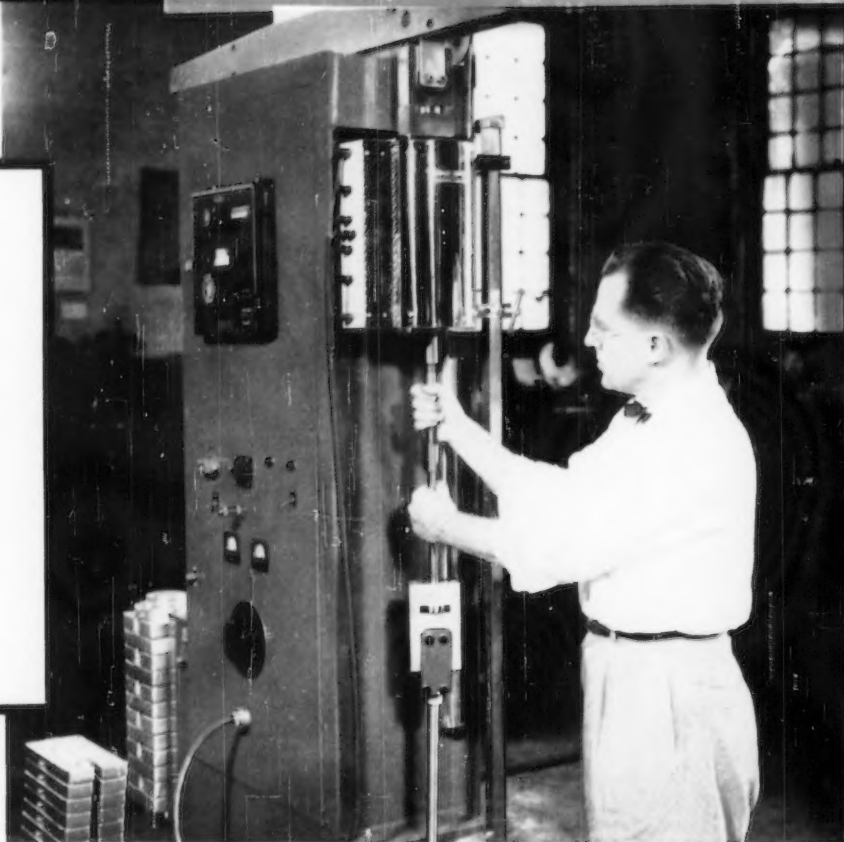
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ANNUAL MEETING REPORT
Sessions—Technical Committees—Standards

American Society for Testing Materials



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JULY 1955

Number 207

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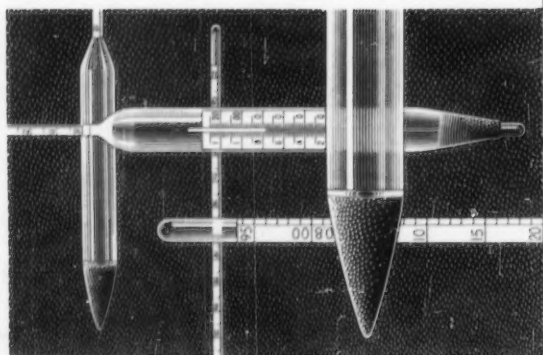
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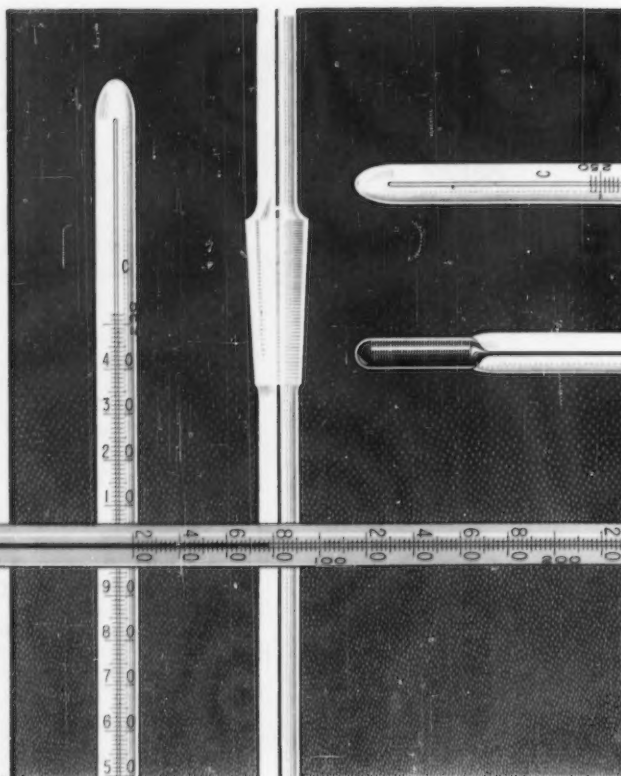
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	1301-A Low-Distortion Oscillator, \$495	20-15,000 cycles (27 fixed frequencies)	18 mw/5.6v 100 mw/30v	600Ω balanced or grounded 5000Ω grounded	<0.1%	Drift not greater than 0.02% per hour after first 10 min. — frequency range extends to 2 cps with 1301-P1 Extension Unit.
	1202-A Oscillator, \$430	10-100,000 cycles	40 mw/10v 20 mw/5v 80 mw/20v	600Ω balanced 300Ω grounded 5000Ω grounded	<0.5% <1%	Output Voltage Constant ±1.0 db.
	1303-A Two-Digital Audio Generator, \$1450	(1) 20-20,000 cycles (2) 20,000-40,000 cycles (3) Two signals separately adjustable (4) Two signals with a fixed difference	Normal 10 mw/5v High 1 w/50v	600Ω grounded	<0.2% <1%	Ideal for intermodulation distortion testing — drift less than 1c in first hour, completed in 2 hrs. — output constant within ±0.1 db.
	1304-B Beat-Frequency Oscillator, \$555	20-20,000 cycles 20,000-40,000 cycles	1 w/50v	600Ω balanced or grounded	<1%	Converts to Sweep Oscillator with 908-P — high stability, low hum.
Medium and High Frequency	1214-A Unit Oscillator, \$66	400, 1000 cycles (2 fixed frequencies)	210 mw/80v	8000Ω grounded or ungrounded	<3%	Has built-in power supply unlike most Unit Oscillators.
	1307-A Transistor Oscillator, \$68	400, 1000 cycles (2 fixed frequencies)	6 mw/2v	600Ω	<5%	Battery operated, with output meter — small and compact.
	753-C and D Vacuum-Tube Forks, \$185	400 or 1000 cycles (2 models)	50 mw/31v max.	50, 500, 5000Ω	<0.5%	Frequency accuracy to ±0.05% — max. drift 0.2% occurs first 30 min.
VHF and UHF	700-A Wide-Range Beat- Frequency Oscillator, \$750	50 cycles — 40 kc 10 kc — 5 Mc	0.1 w/10-15v	3500Ω pot.	<3%	Log frequency calibration, high voltage, and frequency stability — has incremental frequency control.
	1330-A Bridge Oscillator, \$525	400 cycles, 1000 cycles 5 kc — 50 Mc	0.75 w/12v 1 w/10v	50Ω 25-80Ω	<3%	Internal 400- and 1000-cycle modulation — excellent shielding for bridge work.
	1211-A Unit Oscillator, \$395	0.5-5 Mc 5-50 Mc	2 w 200 mw	50Ω	Converted to Sweep Oscillators with unique 1750-A Sweep Drive — output regulated with 1263-A Amplifying Power Supply (described below).	Compact, inexpensive, well shielded — frequency increments of 0.2% per division.
Special Purpose	1215-B Unit Oscillator, \$190	50-250 Mc	80 mw	50Ω		Semi-butterfly tuned circuit with no moving contacts.
	1208-B Unit Oscillator, \$190	65-500 Mc	100 mw	50Ω		Very wide range, thorough shielding.
	1209-B Unit Oscillator, \$335	250-920 Mc	200 mw	50Ω	Butterfly circuit avoids uhf tuning difficulties — excellent stability.	Audio, pulse, square-wave or frequency modulation from external source.
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	1217-A Unit Pulser, \$235	30 c — 100 kc (17 fixed frequencies)	20v	200Ω positive pulses, 1500Ω negative pulses	Noise Spectrum	Stability, 1 ppm per day — fine frequency adjustment provided.
	1213-AB Crystal Oscillator, \$120	1 Mc Crystal provides harmonics of 10 kc, 100kc, 1Mc, up to 1000 Mc.	6v at 10 kc, 100 kc 1v at 1 Mc	varies with frequency		Invaluable audio-test tool — high, uniform spectrum level over range.
	1390-A Random Noise Generator, \$340	30 cycles — 20 kc 30 cycles — 500 kc 30 cycles — 3 Mc	1v	800Ω grounded		

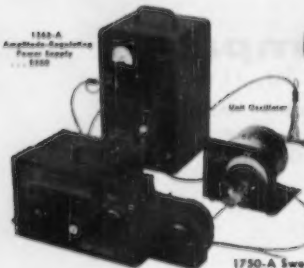
1210-B, 1211-A, 1215-B, 1208-B, 1209-B, 1218-A, 1217-A,
1213-AB Require type 1203-A Unit Power Supply \$40.



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	Frequency Range	Output	Characteristics
1001-A \$495	5kc — 50 Mc 8 direct-reading ranges	0.1v-200 mv, 100Ω jack becomes 500Ω with series unit supplied. 250Ω at end of output cable — 2v at 300Ω from 2nd jack	Incremental dial indicates 0.1% of frequency per division — modulation adjustable 0-80%, indicated on meter, 400c internal or 20-15,000c external am — ±1% calibration, high stability, low drift and negligible leakage and incidental fm.
808-C \$1495	16 kc — 50 Mc 7 direct-reading ranges	Less than 0.1v to 1 v — 750Ω at panel, 750Ω cable has termination impedance of 37.5, 7.1 and 0.75Ω	Internal and external modulation variable 0 to 100%, indicated on meter — drift less than ±0.1% during 5 hrs. continuous operation — ±1% calibration, frequency increments as small as 0.01% — less than 0.05% incidental fm for full 100% modulation — no leakage or excessive harmonic distortion, no cable errors.
1021-AV \$595	40-250 Mc in one band	0.5v — 1v at 50Ω	Butterfly tuning circuit has no sliding contacts, no noise, good stability and very low drift — internal 1 kc and external amplitude modulation adjustable from 0 to 50% — incidental fm under 100 ppm over most of range.
1021-AU \$615	250-920 Mc one band	0.5v — 1v at 50Ω	UHF pencil tube with tuned plate and cathode, remarkably free of noise modulation — ±1% calibration, incremental frequency control for small adjustments — drift under 0.1% per day — 100-10,000 cycles square-wave modulation from external source — stray fields cannot be detected with receiver having 2μv sensitivity.
1021-AW \$645	900-2000 Mc one band	0.5v — 1v at 50Ω	

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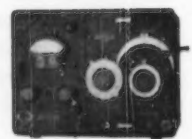
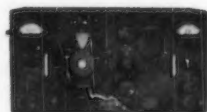
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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 207

July, 1955

High Level of Interest and Activity at 58th Annual Meeting in Atlantic City

32 Sessions and Over 700 Technical Committee Group Meetings Held

MORE than 2500 ASTM members and guests, convening in Atlantic City June 27-July 1, heard scores of authoritative papers spanning a wide range of technical subjects of considerable current interest such as metals at high temperatures, high-purity water corrosion, impact testing, soils, concrete, pyrometry, fatigue, and speed of testing.

Along with these sessions, which also included the Marburg and Gillett Lectures on textiles and powder metallurgy respectively, over 700 committee meetings were held.

Consistently good attendance and brisk discussion at the sessions indicated a high level of interest and timeliness in the papers presented. Photographs and information on the sessions, committee meetings, lectures, President's Luncheon, honorary members, Awards of Merit and various medalists are given in the following pages.

NEW OFFICERS

C. H. FELLOWS, Director, Engineering Laboratory and Research Department, The Detroit Edison Co., was elected President for 1955-1956, succeeding Norman L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., Lester Branch, who continues on the Board of Directors for three years.

R. T. Kropf, Vice-President and Director of Research, Belding Hem-inway Co., Inc., New York, N. Y., is the new Vice-President.

The new members of the Board of Directors are:

- R. C. Alden, Chairman, Research Planning Board, Phillips Petroleum Co., Bartlesville, Okla.
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These new officers together with R.



President Fellows

A. Schatzel, Vice-President and Director of Engineering, Rome Cable Corp., Rome, N. Y., who is the Senior Vice-President of the Society, and ten other Board members elected in the two previous years, will constitute the 1955-1956 officers.

MARBURG LECTURE

ESTABLISHED to emphasize the Society's function of promoting knowledge of materials, the Annual Marburg Lecture honors and perpetuates the memory of Edgar

Marburg, first secretary of the Society. This year the Lecture was presented by Dr. Walter J. Hamburger who is Director of Fabric Research Laboratories, Inc., and a well known textile scientist.

Dr. Hamburger has spent a quarter of a century in the textile field and is the author of many technical papers on the subject of textiles.

Speaking on the subject, "A Technology for the Analysis, Design and Use of Textile Structures as Engineering Materials," Dr. Hamburger traced textile craftsmanship from its beginnings in antiquity through the industrial revolution to the present, with particular emphasis on the last decade. It was only a decade ago that Harold DeWitt Smith presented the classic 19th Marburg Lecture on "Textile Fibers—An Engineering Approach to Their Properties and Their Utilization," which together with the work of F. T. Peirce in England, established the basis for modern textile science and consideration of textiles as engineering materials. Dr. Hamburger amplified and brought up to date the engineering design concepts for textiles expressed by Smith and Peirce.

He pointed out that inherent properties of textile fibers comprise two groups, the simple basic properties such as ultimate strength, elongation, modulus of elasticity, etc., and the complex properties involving interactions of basic properties which together with geometrical and shape considerations, are called "form factors." The shape of the fiber cross-section together with such geometrical factors as helix angle of yarns, fabric weave, crimp, cover factor, yarn diameter etc., go to make up the form factor.

Dr. Hamburger referred to the fact that the scientist has at his disposal a wide variety of materials from which to construct the desired end item. Properties range from the highly elastic,



W. J. Hamburger—Marburg Lecturer

high modulus natural fiber—ramie, to undrawn nylon which manifests behavior nearly comparable with a perfectly plastic medium. Between these extremes lie fibers with a wide variety of stress-strain and rupture characteristics.

In general stress-strain curves for textile fibers may be broken down into three more or less distinct regions—the initial slope region, the yield region, and the post yield region.

Structural steel designs are based on properties of elastic modulus in the order of 30,000,000 psi, yield stress of the order of 40,000 psi and corresponding yield strain of 0.133 per cent. While the design engineer in structural steel is concerned with the stress-carrying ability and works in a small range of deflection, the textile designer on the other hand, though he deals with materials which exhibit yield stress of the same order of magnitude as structural steel, must be concerned with strains from 20 to 200 times those of steel. Though the fabric as a whole may exhibit large strains as indicated above, the individual fibers which compose the fabric are subjected to strains of a considerably lower order. Of particular importance for certain textiles as wearing apparel, white goods, decorative fabrics, etc., is the initial portion of the stress-strain curves at strains ranging from 1 to 3 per cent.

While fibers which manifest pronounced yielding are undesirable where dimensional stability is desired, they are advantageous in uses where knotting or other high local stress concentrations occur. Rope is an example of a structure where a pronounced yielding is desirable, thus leading to higher knot strength.

Dr. Hamburger proceeded to describe the stress-analysis technique for yarns and then for fabric structures—techniques which have been used

successfully in predicting certain aspects of potential performance characteristics of experimental fibers where the sample size was quite limited. He indicated that although application of engineering design techniques to textile structures had progressed greatly in the last decade, there is considerable opportunity for further effort in a scientific and engineering approach to certain performance characteristics. Some which are currently being investigated in detail are resistance to tearing, dimensional stability, biaxial stress behavior, and effect of yarn and fabric design upon air permeability.

GILLETT LECTURE

The subject of the fourth Gillett Memorial Lecture "Power Metallurgy—Now" is one which has developed rapidly since World War II. The lecturer, Fritz V. Lenel, Professor of Metallurgy, Rensselaer Polytechnic



Vice-President Kropf Introduced Dr. Hamburger

Inst., has been working in this field in this country since he finished his academic work in Germany in 1933.

Producing finished parts from metal powders where such parts can be made more economically from powders than by other fabricating methods is a relatively recent development. Although this was originally an American idea, very significant contributions have been made abroad. Such "structural parts" do not necessarily bear structural loads, but are made by powder metallurgy in competition with other fabricating methods.

The lecturer pointed out that many machine "structural parts" are made from wrought steel, not because the mechanical properties of the steel are needed, but because steel is the cheapest raw material. The question of what strength, ductility, and toughness are actually needed should therefore be considered critically before a high-strength material is specified where a powder part might be used. If a

material is specified of higher strength and therefore higher cost than is really required, the expected savings due to fabrication from powders may well be illusory.

Prof. Lenel presented a series of examples of machine parts with improved mechanical properties, all of which have been or are in quantity commercial production. With each example the lecturer told how the parts were made, the advantages and limitations, difficulties overcome, and the mechanical properties resulting. When they originally appeared in the industrial picture (late 1930's), mechanical properties of the order of a medium grade of cast iron were obtained (20,000 to 25,000 psi with a nominal elongation). Alloy steel powder is now used to compact into gears which are heat treated to a hardness of 30 Rc.

The lecturer briefly described the production of semifabricated products such as extrusions, forgings, sheet, rod, and wire from powder which has properties superior to those made by fusion metallurgy. Mention was made that these techniques have been particularly successful in the field of light metals.

Also described were the contributions of powder metallurgy in the development of materials possessing high strength at elevated temperatures, highly needed in such places as aircraft propulsion and atomic energy. The thermal shock sensitivity of cermets appears to have been overcome and the present principal research effort is directed toward increasing their inherently low toughness.

Each year the Gillett Lecture covers a subject pertaining to the development, testing, evaluation and application of metals. It commemorates Horace W. Gillett, the first Director of Battelle Memorial Institute, and is sponsored jointly by ASTM and Battelle.



F. V. Lenel—Gillett Lecturer

ENTERTAINMENT

Haddon Hall's air conditioned Vernon Room was taxed to capacity by the members who, in a strenuous week, took time to relax on Wednesday evening at the cocktail party, dinner, and dance.

The more than 200 women who were present during the week, enjoyed an unusually pleasant entertainment program which included a flower arrangement demonstration, fashion show, an ocean cruise off Atlantic City, and a smorgasbord luncheon with a talk by Rae V. Biester, Superintendent of the U. S. Mint.

As especially enjoyed event of the ladies program was the daily coffee hour held in the cool and spacious lounge floor of Haddon Hall.

TECHNICAL SESSIONS

REFERENCE has already been made to the Gillett Lecture and the Edgar Marburg Lecture to which two of the technical sessions were devoted and which comprise an important part of the technical activities. In all there were thirty-two technical sessions and apart from taking care of essential Society action on committee recommendations to which several sessions were exclusively devoted, many phases of the Society work were pointed up in the various technical sessions devoted to the holding of symposiums and presentation of technical papers.

Timeliness of subjects of particular significance was the emphasis placed upon matters of concern with respect to newer developments in the nuclear and high-temperature power field. Of outstanding significance in this connection was the Symposium on High-Purity Water since this is a most important subject both in the operation of the high temperature, high pressure generators and also in connection with the operation of nuclear

reactors. Similarly there are papers dealing with the effect of radiation on the normal properties of materials, including both steel and concrete, and also papers dealing with the methods of testing materials under radiation conditions such as descriptions of the remote control testing apparatus. Two sessions were devoted to the Symposium on Metallic Materials for Service at Temperatures Above 1600 F, and these sessions, which attracted a very interested audience were perhaps the highlight of the week.

High-Purity Water Corrosion

High-purity water is of particular importance in nuclear reactor systems and much of the material presented was directly related to such systems.

Methods of preparing and maintaining high-purity water were covered in a paper by F. N. Alquist, in which he discussed such points as purification of the water by ion exchange, the effect of oxygen in the water on corrosion, a testing program for development of materials of high-temperature use in high purity water, and methods of analysis for metal ions and corrosion products.

The effect of material composition on corrosion in high-purity water at high temperatures was covered in papers by A. H. Roebuck and by R. U. Blaser. While high-alloy steels and other special corrosion-resistant alloys were found to

exhibit high corrosion resistance, it was pointed out that there is evidence that carbon steel may have adequate corrosion resistance for many applications using high-purity water, including nuclear reactor systems.

The effect of water composition on corrosion in high temperature, high-purity water was discussed in the paper by D. M. Wroughton, J. M. Seamon, and P. E. Brown. The authors pointed out that the effect of water composition on the nature or behavior of corrosion products may, in some instances, be of greater importance than its effect on corrosion.

The water requirements of various parts of atomic reactor cooling systems, for reactors for power sources as well as for reactors for nonpower applications, were covered by a paper by H. W. Huntley and S. Untermyer. The authors discussed the possible sources of radioactivity in the system, means of minimizing activity due to impurities in the water by efficient removal of them, proper selection of materials of construction, etc.

Metallic Materials for Service at Temperatures Above 1600 F

The 1600-F limit to which designers are currently confined for want of materials capable of satisfactorily withstanding higher temperatures of operation must be increased to 1800 F,

(Continued on page 9)

REGISTRATION—ANNUAL MEETINGS.

	Year	Members	Committee Members	Visitors	Total	Ladies
Detroit.....	1948	1160	358	250	1768	133
Atlantic City.....	1949	1092	530	235	1857	335
Atlantic City.....	1950	1160	637	334	2131	408
Atlantic City.....	1951	1220	660	402	2282	393
New York.....	1952	1375	674	557	2606	280
Atlantic City.....	1953	1290	786	394	2470	445
Chicago.....	1954	1223	700	306	2224	178
Atlantic City.....	1955	1341	862	323	2537	234

SUMMARY OF ACTIONS TAKEN AT 1955 ANNUAL MEETING AFFECTING STANDARDS AND TENTATIVES.

	Existing Tentatives Adopted as Standard	Standards in Which Revisions Will Be Adopted	New Tentatives	Revisions of Standard and Reversions to Tentative	Tentative Revisions of Standards	Existing Tentatives Revised	Standards and Tentatives Withdrawn
A. Ferrous Metals—Steel, Cast Iron, Wrought Iron, Alloys, etc.....	22	22	6	4	...	41	6
B. Non-Ferrous Metals—Copper, Zinc, Lead, Aluminum, Alloys, etc.....	9	45	6	...	...	23	3
C. Cement, Lime, Gypsum, Concrete and Clay Products.....	20	28	19	8	6	20	1
D. Paints, Petroleum Products, Bituminous Materials, Paper, Textiles, Plastics, Rubber, Soap, Water, etc.....	38	42	30	13	12	75	5
E. Miscellaneous Subjects, Testing, etc.....	3	4	4	2	...	2	...
Total.....	92	141	65	27	18	161	15



Seated at the Head Table at the President's Luncheon Held During the Annual Meeting are left to right: R. E. Hess, Associate Executive Secretary; F. V. Lenel, Gillett Lecturer; Past-President T. S. Fuller; Vice-President R. A. Schatzel; A. W. Carpenter, Honorary Member; Vice-President R. T. Kropf;

PRESIDENT'S LUNCHEON

On Tuesday, June 28, members and guests participated in the President's Luncheon, an impressive, fast-moving session that has become an increasingly popular feature of the Annual Meetings.

Presided over by Past President L. C. Beard, Jr., the Luncheon honored retiring President Norman L. Moche! whose traditional President's Address titled "What Is It?" dealt with the growing need for better identification and marking of materials. Speaking of the need for individual identification of products such as piping in which a minute addition of alloy can make a critical difference in strength and endurance, Mr. Moche! said, "It is easy to identify some things; it is very difficult to identify others. But the difficulty of doing it must not be accepted as the reason for not doing it." (The complete text of this address appears on page 53 of this BULLETIN.)

Following the President's Address, R. J. Painter, Executive Secretary, read the report of the Board of Directors, which disclosed that the Society has completed a successful year marked by a substantial increase in membership (particularly in the Sustaining Membership class) and expansion into several new fields of standardization and research.

The Directors Report also included a recommendation to amend the By-laws to change the "Junior Membership" class to an "Associate Membership" with transfer to full membership at age 30.

Chairman Beard then introduced incoming President C. H. Fellows and Vice-President R. T. Kropf who acknowledged their election with brief statements pledging their continuing efforts in furthering the work of the Society.

Also introduced by the chairman were the five new directors of the Society. (For pictures and biographies of the new officers, see page 10. Election

tellers were F. G. Tatnall and Percival Theel.)

Honors conferred by the President on behalf of the Board of Directors included, honorary memberships to W. M. Barr, T. A. Boyd, A. W. Carpenter, and R. L. Templin (whose award because of illness, was accepted by his son, Gordon Templin).

Awards of Merit were bestowed on eleven men who were presented to

50-YEAR MEMBERS

H. C. Berry
W. C. Hanna
R. H. Harry Stanger
Engineers' Society of Western
Pennsylvania

Marquette Cement Manufacturing Co.
Pittsburgh Testing Laboratory
Worcester Polytechnic Inst.
York Corp.

40-YEAR MEMBERS

Julius Adler
University of Akron, Bierce Library
Alpha Portland Cement Co.
The Babcock & Wilcox Co.
Hyman Bornstein
Forest Products Laboratories of Canada
The Central Railroad Co. of New Jersey
Certain-teed Products Corp.
Harold F. Clemmer
Concrete Products Co. of America
Irving H. Cowdrey
R. Robertson Deans
Deere and Co.
E. I. du Pont de Nemours & Co., Inc.,
Pigments Department
Ecole Polytechnique
Erie Forge and Steel Corp.
Fay, Spofford & Thorndike, Consulting
Engineers
Walter H. Flood
Glens Falls Portland Cement Co.
James E. Heckel

George A. Johnson
Keasbey & Mattison Co.
C. F. Kettering
A. E. Legg
F. B. Lysle
Paul D. Merica
Moody Engineering Co.
NATCO Corp.
New York Public Library, Reference
Department
North American Cement Corp.
Patton Clay Manufacturing Co.
Pittsburgh Testing Laboratory
Rhode Island Dept. of Public Works,
Div. of Roads & Bridges
Richard E. Schmidt
Scott Testers, Inc.
Fred B. Seely
Oliver W. Storey
United States Metals Refining Co.
Country Roads Board of Victoria
Franklin A. Wertz



President N. L. Mochel; Past-President L. C. Beard; Incoming President C. H. Fellows; T. A. Boyd, Honorary Member; W. J. Hamburger, Marburg Lecturer; W. M. Barr, Honorary Member; C. R. Stock, Chairman, Award of Merit Committee; R. J. Painter, Executive Secretary.

Annual Meeting Report

(Continued from page 7)

President Mochel by C. R. Stock, chairman of the Award of Merit Committee. All were at the luncheon to receive these awards except C. E. Loos whose illness prevented his attending. For more about the honorary membership and Award of Merit recipients, see pages 12 and 16.

Recognition was also given at the luncheon to those individuals and companies who have held continuous membership in the Society for 40 and 50 years. A complete list of these names appears on page 8.

At the close of the meeting Chairman Beard introduced Past President T. S. Fuller who retired from the Board after eight years' service, and the five retiring directors: G. R. Gohn, W. H. Lutz, H. K. Nason, A. O. Schaefer, and M. A. Swayze.

Summary of Proceedings and Letter Ballot

THE Summary of Proceedings of the Annual Meeting, setting forth the actions taken at the meeting, will shortly be placed in the mails to all members in good standing. It will be accompanied by a letter on all recommendations calling for formal adoption as standard. The ballot is to be canvassed September 12.

Sessions

2000 F, or even higher if increasingly efficient and improved operations are to be expected in turbines, jet engines and guided missiles of the future. It is hoped that the Symposium on Metallic Materials for Service at Temperatures Above 1600 F, sponsored by the Research Panel of the ASTM-ASME Joint Committee on Effect of Temperatures on the Properties of Metals may provide a partial solution of this problem.

Three of the papers in the symposium, including two contributions from England, centered on the Nimonic and other high-nickel alloys. Betteridge and Smith showed that differences in the stress-rupture properties at 750 C of nickel-chromium-cobalt alloys hardened with titanium and aluminum are maintained at all temperatures up to 950 C. Ward and Tallis showed that the strength properties of Nimonic 95 appear significantly higher at 1000 C (1830 F) and those of the other alloys tested including the Nimonics 75, 80A, and 90. Throughout the temperature range studied, Nimonic 75 had markedly higher reduction-of-area values. H. E. Lardge, in his discussion of Thermal Fatigue Testing of Sheet Metal, presented a useful guide in the selection of materials for the manufacture of gas-turbine equipment and similar projects from the standpoint of thermal fatigue. In addition to the Nimonics, Lardge discussed Inconel, austenitic stainless

steels, and aluminized and chromized mild steel.

Further papers on the cobalt-base, nickel-cobalt, and chromium-nickel alloys were presented by Reynolds, Breen, Manson, and Grant. The paper by Reynolds, *et al.*, indicated that boron adversely affects forgeability of cobalt-base alloys of the S-816 type. Conversely, boron additions improve rupture strength up to an optimum of about 1 per cent. This optimum alloy has rupture strengths at 1650 F equivalent to those of wrought S-816 at 1500 F. Breen and Lane showed increased rupture strength results from rare-earth additions to cobalt-base alloys. An improvement in ductility also resulted, with the greatest improvement at 1500 F. The data obtained from stress-rupture and other tests on Inco 700 alloy, containing 46 per cent nickel, 29 per cent cobalt and minor percentages of aluminum, titanium, and molybdenum indicate that this alloy shows promise for use at a temperature of 1600 F and perhaps higher. At 1600 F it is considerably stronger than alloys such as Inconel X, S-816, and M-252.

Grant and Bucklin in their survey of chromium-nickel alloys containing 2 to 10 per cent of iron, molybdenum, and columbium, showed that alloys containing 40 to 45 per cent chromium can be air melted to produce alloys equal to or better than forged S-816 in the temperature range of 1600 F to 1800 F.

(Continued on page 14)



NEW OFFICERS

President



Vice President

Claire H. Fellows, Director, Engineering Laboratory and Research Dept., The Detroit Edison Co., has held this position since 1952.

A native of Kalamazoo, Mich., Mr. Fellows was graduated from Purdue University with a Bachelor of Science degree in Chemical Engineering and has been associated with Detroit Edison since 1919. Mr. Fellows was a pioneer in the study of water treatment and corrosion problems in steam generating plants and has written many papers and reports in this field.

Since joining ASTM in 1931, the President has served as Director for two separate terms and has been Vice-President since 1953. He is active in the work of Committees D-9 on Electrical Insulating Materials, D-19 on Industrial Water, D-2 on Petroleum Products and Lubricants, and A-5 on Corrosion of Iron and Steel. Other contributions to the Society have been many years of work in the ASTM Detroit District Council in which he served as chairman; chairmanship of the Society's Administrative Committee on District Activities and chairmanship of the Joint Research Committee on Boiler Feedwater Studies. He is currently the Society's representative on the executive committee of the latter group.

In addition to ASTM, Mr. Fellows is a member of the American Chemical Society, National Association of Corrosion Engineers, American Water Works Assn., American Association for the Advancement of Science, and the Engineering Society of Detroit.

Richard T. Kropf, Vice-President and Director of Research, Belding Heminway Co., Inc., has held this position in the Industrial Thread Division since 1949.

Mr. Kropf was born in Chicago, and following graduation from the Massachusetts Institute of Technology became associated with Belding Heminway as research engineer in Michigan in 1931. He was transferred to Connecticut in the same capacity in 1933; was Laboratory Director from 1934 to 1938 and moved to New York where he served as Merchandise Manager and Technical Director from 1938 to 1943 when he was named Director of Research. During this period he did extensive work in the field of natural and synthetic fiber yarn and thread, mechanical applications of textiles, and development and design of sewing threads and yarns for specific mechanical and chemical applications.

Mr. Kropf has been a member of ASTM since 1944 and has been active on Committee D-13 on Textile Materials, currently serving as First Vice-Chairman of Subcommittee C-2 on Papers. He is also a member of the Advisory Subcommittee and other working groups.

In addition to ASTM, Mr. Kropf is a member of the American Chemical Society, American Physical Society, the Fiber Society (Past-President and at present, Treasurer) New York Academy of Science, Textile Research Inst., American Association of Textile Technologists, Technical Industrial Intelligence Committee; and has served as Scientific Consultant to the Quartermaster General.

Richard C. Alden, Chairman, Research Planning Board, Phillips Petroleum Co., has been with the Research Department of the Phillips Petroleum Co. since 1925, shortly after it was organized. He became Assistant Director in 1930, Director of Research in 1933, and Chairman of the Research Planning Board in 1950. With Phillips he has played an active part in that company's pioneering developments in such important fields as liquefied petroleum gas, aviation gasoline, synthetic rubber, motor fuel, lubricants, light hydrocarbons, petrochemicals, and natural gasoline.

Mr. Alden has been active in ASTM work since 1939 and is now First Vice-Chairman of Committee D-2 on Petroleum Products and Lubricants and a member of the Administrative Committee on Research. He holds offices or membership in several subcommittees of Committee D-2 and is a member of one Subcommittee in Committee D-11 on Rubber. He is also a Vice-Chairman of the ASTM Southwest District Council.

Mr. Alden, born in Harrisburg, Pa., was graduated from Lehigh University in 1918. After graduation and following a tour of duty in the Signal Corps during World War I, he worked successively for Bethlehem Steel Co. at Sparrows Point, Md., and Bethlehem, Pa.; as research chemist for Chestnut & Smith Corp. in Oklahoma and Texas; as a partner in Seeley-Oberfell Engineering Corp., Breckenridge, Texas; as plant superintendent, Landreth Gasoline Co., Ilex, Texas; and as California sales engineer, Gasoline Recovery Corp., Charleston, W. Va.

Mr. Alden is the author of many papers and a co-author of one book. He is a member of the American Chemical Society, American Association for the Advancement of Science, and several trade associations.



Director

A. Allan Bates, Vice-President for Research and Development, Portland Cement Assn., has held this position since 1946. He joined the organization after eight years as manager of Chemical and Metallurgical Research at Westinghouse Electric Corp.

A native of Elyria, Ohio, Dr. Bates was graduated from Ohio Wesleyan University with a B.A. degree in 1923. He received the degree of Doctor of Science from the University of Nancy, in France in 1931. Stevens Institute of Technology awarded him an honorary degree of Doctor of Engineering in 1944 and Rose Polytechnic Inst. the honorary degree of Doctor of Science in 1947. Dr. Bates was also Professor of Engineering Metallurgical Engineering for two periods at Case School of Applied Science and during World War II served on special missions for the State Department in South America and later for the Army in Europe.

Dr. Bates has been active in ASTM work for many years as representative of the Portland Cement Assn. on Committee C-1 on Cement and as a member of Committee E-10 on Radioactive Isotopes. He is also a member of the American Chemical Society, American Society for Metals, the Institute of Mining and Metallurgical Engineers (England) the American Concrete Institute (in which he has been a Director), Sigma Xi, and Tau Beta Pi.



Director



Director

Frank L. LaQue, Vice-President and Manager, Development and Research Division, The International Nickel Co., was previously head of the Corrosion Engineering Section of that Division from 1945 until 1954 when he assumed his present title.

Mr. LaQue was born in Gananoque, Ontario, Canada, and was a 1927 graduate of Queen's University, Ontario, in Chemical and Metallurgical Engineering. Upon graduation he joined International Nickel Co.'s Development and Research Division and has since devoted his activities to the field of corrosion and corrosion-resistant materials. He was Assistant Director of Technical Service on Mill Products from 1937 until April, 1940, when he became engaged in development activities on all applications of both ferrous and non-ferrous nickel containing alloys. Under his leadership, the well-known corrosion testing stations of the company at Kure Beach and Harbor Island, N. C., were established.

A member of ASTM since 1935, Mr. LaQue is currently chairman of the ASTM Advisory Committee on Corrosion and in 1951 delivered the Marburg Lecture on "Corrosion Testing." He is also a member of Committees B-3 on Corrosion of Non-Ferrous Metals and Alloys, A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, D-19 on Industrial Water, and the Administrative Committee on Papers and Publications.

In 1949 Mr. LaQue was the recipient of the F. N. Speller award in Corrosion Engineering of the National Association of Corrosion Engineers of which he is Past President. He is also a member of the Corrosion Advisory Committee, Prevention of Deterioration Center, and the National Research Council. He has written numerous articles and papers on corrosion.

E. F. Lundeen, Assistant Superintendent, Quality Control Department, Inland Steel Co., has been with the Inland Steel Co. for the past 14 years.

He was graduated from Carnegie Institute of Technology with a B.S. in Metallurgical Engineering in 1918 and worked as a metallurgist for the A. C. Spark Plug Co. and the General Motors Corp. until 1922 when he became research engineer for the Willard Storage Battery Co. In 1927 he became Business Director of Research for the Armco Steel Corp. until he joined the Inland Steel Co.'s staff.

Mr. Lundeen has been associated with ASTM since 1941 as representative of the Inland Steel Co. on Committees A-1 on Steel and A-5 on Corrosion of Iron and Steel; as Chairman of Subcommittee XIX on Sheet Steel and Steel Sheets of Committee A-1; Chairman of Subcommittee XI on Sheet Specifications of Committee A-5; and Chairman of Subcommittee 24 on Cupping Tests of Committee E-1 on Methods of Testing.

Active also in other societies, Mr. Lundeen has been Chairman of the American Iron and Steel Inst.'s Technical Committee on Sheets and a member of the Society of Automotive Engineers' Panel A of the Iron and Steel Technical Committee.



Director



Director

John C. Moore, Director, Technical Section, National Paint, Varnish and Lacquer Association, was formerly Director of the Scientific Section of the Association for about seven years and prior to that was Superintendent of the Sinclair Refining Company's paint plant for thirteen years.

Mr. Moore was born in Matador, Texas, and was a 1922 graduate of Texas A & M College with a B.S. in Chemical Engineering. For twelve years after college he held operational, technical, and executive positions in the oil industry before taking charge of the Sinclair paint plant.

During World War II, Mr. Moore was a member of the Technical Advisory Committee of the Protective Coatings Section, War Production Board, and served as Chairman for five years on the Federation Technical Advisory Committee, which cooperated with various branches of the armed forces.

Mr. Moore has been a member of ASTM since 1934 and has been very active in Committee D-1 on Paint, Varnish, Lacquer, and Related Products. He has also represented the Society on several joint committees. He is a member of the American Chemical Society, and a Fellow of the American Institute of Chemists. He was president of the Federation of Paint and Varnish Clubs in 1947 and Treasurer in 1946. He is Past President of the Philadelphia Paint and Varnish Club.

Mr. Moore has been active in the Boy Scouts of America since 1926 and presently is a member of the National Council of that organization.

HONORARY MEMBERSHIPS

The Society's Most Signal Honor

William M. Barr

William Milton Barr, retired Chemical and Metallurgical Engineer, Research and Standards Consultant, Los Angeles, Calif., was born in West Union, Iowa. He was graduated from the University of Iowa (B.Sc.) in 1902, Grinnell College (M.A.) 1904, and the University of Pennsylvania (Ph.D.) in 1908, and served for some time on the faculties of all three institutions. For ten years he was associated with the Mallinckrodt Chemical Works in various capacities at several plants, from 1912 to 1916 as Manager and Chemical Director of the Eastern (New Jersey) plant.

From 1916 until retirement in 1954 he was with the Union Pacific Railroad Co., successively as Consulting Chemist, Assistant to the Executive Vice-President, and later Chief Chemical and Metallurgical Engineer, in which position he had charge of laboratories, water supply, inspection, tests of, and specifications for materials. He furthered important work in the improvement and handling of water supplies for locomotives, and in the development of alloy steel forgings for railway service. He has been recognized widely for his contributions as a consultant on engine water treatment, engine failures, metallurgy of steel for locomotives, lubrication of steam and diesel locomotives, and railroad chemical problems; and has written papers on these subjects.

Dr. Barr joined ASTM in 1922, and has been very active through the years, his most intensive service being in Committee A-1 on Steel, where he participated in the Advisory group deliberations, and in the activities of many of the subcommittees. He was vice-chairman of Committee A-1 for several years, and headed Subcommittee VI on Steel Forgings and Billets from 1936 to 1940. In recognition of his longtime services and important contributions, Committee A-1 elected him to honorary membership in their group in 1950.

He served for varying periods on ASTM committees concerned with wrought iron, lime, paint, varnish, lacquer, and related products, and petroleum; and represented Committee

A-1 on Committees E-1 on Methods of Testing and E-3 on Chemical Analysis of Metals.

Dr. Barr also aided in administrative phases of the Society's work as a member of the Executive Committee (now Board of Directors) 1934-1936; Vice-President of the Society from 1938 to 1940, and President 1940-1941.



W. M. Barr

Thomas A. Boyd

Thomas Alvin Boyd, Research Consultant (Retired), General Motors Corp., Research Laboratories Div., was born in Fairview, Ohio and was graduated from Ohio State University (B.Ch.E.) in 1918. He received his Chemical Engineering degree in 1938 from the same institution, and was awarded honorary degrees of Doctor of Engineering by Ohio State University and the University of Detroit.

Following graduation Mr. Boyd became associated with Dayton Metal Products Co. as Research Chemist, and when the Research Division of that company became a part of the General Motors Corp. in 1920, forming the basis of the GM Central Research Division, he continued with this work. From 1923 to 1947 he was head of the Fuel Department of the GM Research Laboratories Division, and since 1947 has been engaged as Research Consultant.

Eminent in his field, Mr. Boyd's principal subject of research through the years has been automobile and aircraft fuels. Out of his researches have come several important contributions to high-output fuels, including chemical antiknock agents. He was co-discoverer with C. F. Kettering and Thomas Midgley, Jr., of antiknock compounds, including the organic compounds used in a large portion of all gasolines now sold. A prolific writer, Mr. Boyd is author or co-author of over 50 technical

papers and articles, as well as numerous popular articles. He has written two books: *Gasoline—What Everyone Should Know About It* and *Research, The Pathfinder of Science and Industry*.

Personally affiliated with ASTM since 1930, Mr. Boyd had been active in committee work of the Society for some years prior to that time. His



T. A. Boyd

intensive technical activities have been concentrated in Committee D-2 on Petroleum Products and Lubricants, which group he headed as chairman from 1931 to 1946. In recognition of his years of service and valued contributions, Committee D-2 elected him to honorary membership in their group in 1952.

His other technical committee activities included service for many years on Committees E-1 on Methods of Testing, E-5 on Fire Tests of Materials and Construction, and ASA Sectional Committee Z-11 on Petroleum Products and Lubricants.

Mr. Boyd has been very active also in administrative phases of the Society's work. He was a member of the Executive Committee (now Board of Directors) 1943-1945; Vice-President from 1945 to 1947, and President of the Society 1947-1948. He has been a member of the Detroit District Council since 1935, serving as vice-chairman, 1936-1938, and chairman 1938-1940. He was a member of the Administrative Committee on Research from 1948 to 1954.

He is affiliated with many other technical and professional organizations, including the American Chemical Society, American Institute of Chemical Engineers, American Association for the Advancement of Science, Society of Automotive Engineers, American Petroleum Institute, Michigan Academy of

Sciences, and the Engineering Society of Detroit (President, 1943-1944).

Arthur W. Carpenter

Arthur Whiting Carpenter, retired Manager of Testing Laboratories, The B. F. Goodrich Co., Akron, Ohio, was born in Wellsville, N. Y., and received his B.S. degree in Chemical Engineering from the Massachusetts Institute of Technology in 1913; M.S. in 1914. For two years he was City Chemist, Alliance, Ohio; and for three years, Assistant Superintendent, Akron Municipal Water Purification Plant. He served as an officer overseas in World War I. He was with the Holtite Manufacturing Co., Baltimore, Md., for a short period, and for six years was associated with the Goodyear Tire & Rubber Co., as Development Engineer and Compounder. From 1927 to 1955 he was with The B. F. Goodrich Co. in the capacity mentioned above.



A. W. Carpenter

An outstanding authority in the rubber field, Mr. Carpenter was loaned by Goodrich to the Government during World War II to serve as industry specialist and consultant in the War Production Board Conservation Division, where he rendered valued aid in the rubber conservation program and the utilization of synthetic rubber in the war effort. From September, 1948, to February, 1949, he was loaned to the National Security Resources Board, serving as Assistant Director for Raw Materials, Office of Production; and upon termination of this period he was presented the NSRB Distinguished Service Award in recognition of "outstanding contributions to the work of the NSRB and devotion to the welfare of his country."

A personal member of ASTM since

1931, he has been active since 1928 in Committee D-11 on Rubber and Rubber-Like Materials, serving as secretary of the committee since that year and still continuing in that capacity. He has been a member of at least thirty of the subgroups, heading a number as chairman. Currently he is chairman of the Editorial Subcommittee (XXIX). His service and assistance to the various officers through the years have been invaluable. His contributions in the form of research and development of apparatus and tests have been of a high order.

His other technical committee activities have included service for periods of several years on Committees D-20 on Plastics, E-1 on Methods of Testing, the Administrative Committee on Papers and Publications, former E-9 on Research, and E-11 on Quality Control of Materials.



R. L. Templin

He has rendered very important service also in administrative phases of the Society's work. He was a member of the Executive Committee (now Board of Directors) for two terms, 1931-1933, 1941-1943; was Vice-President, 1944 to 1946, and President 1946-1947. He served for some time on the Administrative Committee on Ultimate Consumer Goods; and since 1947 has been a member of the ASTM Ordnance Advisory Committee. For many years he has been a member of the Cleveland District Council, serving as vice-chairman from 1940 to 1946.

He is affiliated with a number of other technical and professional groups including the American Chemical Society, American Institute of Chemical Engineers, National Society of Professional Engineers, and American Institute of Chemists (Fellow).

Annual Meeting Report

Richard L. Templin

Richard Laurence Templin, Assistant Director of Research and Chief Engineer of Tests, Aluminum Company of America, is a native of Minneapolis, Kans. He received his B.S. in Civil Engineering in 1915 from the University of Kansas, and for post-graduate work at the University of Illinois was awarded the degree of M.S. in Theoretical and Applied Mechanics in 1917.

After two years with the National Bureau of Standards, Washington, D.C., he joined the Pittsburgh staff of the Aluminum Company of America in 1919 as Engineer of Tests. In 1942 he assumed the additional responsibility of Assistant Director of Research. He has been personally responsible for the development of many of the testing methods used today in the inspection and quality control of aluminum products, and has conceived and designed much of the physical testing equipment used in Alcoa's testing laboratories.

A prolific writer and holder of many patents on aluminum fabrication and testing equipment, Mr. Templin is author and co-author of numerous papers and technical reports describing work in the non-ferrous and other fields. Among several awards he has received in recognition of his work was the Dudley Medal given by ASTM in 1934 for his outstanding paper "Fatigue." He was also the Gillett lecturer in 1954.

Mr. Templin's ASTM affiliation dates from 1917, and he has been active in technical committee work since 1927. His most intensive service has been in Committees B-6 on Die-Cast Metals and Alloys, B-7 on Light Metals and Alloys, and E-1 on Methods of Testing. He has been vice-chairman of the last-named group since 1952. He served on the former Research Committee on Fatigue of Metals for 18 years and has continued service on Committee E-9 on Fatigue since its organization in 1946. For many years he has been a member of the Subcommittee on Methods of Test and Sampling Procedure of Committee B-1 on Wires for Electrical Conductors.

He has been active in administrative phases of the Society's work, serving as a member of the Executive Committee (now Board of Directors) from 1937 to 1939, as Vice-President from 1946 to 1948, and President 1948-1949. He served on the Administrative Committee on Simulated Service Testing for nine years, and for some time as a member of the Pittsburgh District Council.

Two papers were presented on titanium carbide products. The paper by Blumenthal, *et al.*, discusses development of titanium-carbide-base cermets containing 26 to 65 per cent of nickel-chromium or nickel-cobalt-chromium binder. The applicability of various parts to be used in the temperature range of 1700 to 1800 F is indicated. Skolnick and Goetzel indicated that the infiltration technique results in impact strength superior to the conventional cermet titanium-carbide materials. At 1800 F, at a stress of 16,000 psi, the life of some of the infiltrated titanium-carbide grades is over 1000 times that of cast X-40. Bruckart and Jaffee in their data indicated that silicon, chromium, aluminum, and tungsten are the most effective elements to increase the creep life of molybdenum at 1800 F. Also of importance is the discovery that dispersions of oxides and probably nonmetallics in general produce minor increase in the creep life of molybdenum at 1800 and 2000 F.

Alan Blainey, of the English Atomic Energy Research establishment, found that production of hard protective coatings of zirconium-rich alloys on the surface of nickel-base alloys for protection against erosion are feasible. Coating hardness can be increased by suitable alloy additions, for example, tungsten, molybdenum, chromium, aluminum, and lead with subsequent suitable heat treatment.

Vitovec and Lazan concluded from their axial stress tests on S-816 alloys that:

1. Stress concentration causes a decrease in fatigue strength and an increase of stress-rupture strength.
2. With increasing time-to-rupture, the ductility of unnotched specimens generally passes through a minimum at intermediate times, then increases to a peak and falls again.
3. Under certain conditions the superposition of alternating stress or mean stress increases the life of unnotched specimens. This effect increases with increasing temperature.

Denny, *et al.*, discussed various alloys including X-40, molybdenum-base alloys, a cermet and sheet alloys Inconel 702 and Hastelloy C. Among his conclusions is the promise of the use of cermets for application up to 1800 F. Beyond this to 2200 or 2300 F current molybdenum alloys are superior in strength. For high stress applications involving exposure of sheet metal to temperatures exceeding 2000 F, resort will have to be made to cooling, insulative ceramic coatings, or protectively-coated molybdenum alloy sheet.

Effect of Temperature

Testing metals at either high or low temperatures is fraught with many problems. Unique methods with clever arrangement of equipment are described in this session. One example shows how helium can be used to get temperatures in extreme low range of -320 to -425 F. E. T. Wessel, Westinghouse Research Laboratories, covered in detail the refrigeration chamber and other equipment and the effective procedure for low-temperature tension testing.

W. F. Brown, Jr., and M. H. Jones in their paper An Axial Loading Creep Machine discussed the limitations of some of the standard methods presently in use to reduce eccentricity in tension loading. The paper also describes the design features of a new creep machine which incorporates loading fixtures that are suitable for conducting routine tests and that provides very low eccentricities of loading.

Three papers dealing with the elevated temperature effect on properties of metals were presented. That by T. A. Hunter, dealing with thermal shock testing, concluded (a) that thermal fatigue is a cumulative process which continues until a crack is initiated, (b) that large variations of thermal shock resistance occur within a given material, and (c) that thermal shock cracking is produced by thermal fatigue except for shapes of greatly varying cross-sections.

William J. O'Sullivan, Jr., investigated the high-temperature thermal and mechanical properties of Inconel of three levels of carbon content. He concludes that although Inconel is not ideally suited for use in aerodynamic heating, it is at present the only material which simultaneously fulfills the requirements that its properties be adequately known, that it be capable of withstanding high temperatures, that it be commercially available in standard structural shapes at reasonable cost, and that it be readily fabricated by ordinary shop methods.

L. A. Yerkovich and G. J. Guarnieri described a compression-creep testing apparatus designed for operation up to 1800 F. In addition, the compression-creep characteristics up to 5 per cent creep were determined for four metallic and two metal-ceramic materials in the temperature range of 1350 F to 1800 F. Their comparison of tension-creep and compression-creep characteristics indicates that metals do not necessarily behave identically under static tension and compression stresses. Also that tension-compression creep behaviors for wrought alloys are probably related to microstructural and orientation effects generated in the processing.

Panel on Pyrometry

A panel Session on Pyrometric Practice in Elevated-Temperature Testing, sponsored by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, was organized by J. J. Kanter, Chairman of the Test Methods Panel. Much interest centers in defining the precision of temperature measurement and control which can be specified in high-temperature test work such as Recommended Practices E 21 (Short-Time Elevated-Temperature Tension Tests of Metallic Materials), E 22 (Conducting Long-Time High-Temperature Tension Tests of Metallic Materials), and E 85 (Conducting Time-for-Rupture Tension Tests of Metallic Materials).

The one formal paper presented was that by J. M. Berry and D. L. Martin of the Alloy Studies Research, General Electric Research Laboratory on Thermocouple Immersion Errors. Two types of "immersion errors" were discussed. The first type occurs when an inhomogeneous portion of a thermocouple is subjected to a temperature gradient; the second type of "immersion error" is related to conduction of heat to or from the hot junction of the thermocouple. To partially resolve the problem the authors suggest it may be well to stabilize thermocouple materials prior to their use or possibly the change in the emf temperature relationship can be detected by recalibration.

Discussion leaders of the Panel included Arnold M. Bass, Temperature Measurement Section, U. S. Bureau of Standards; P. H. Dike, Leeds and Northrup Co.; and J. R. Freeman, University of Michigan, who has campaigned persistently in the joint high temperature group for a rationale of high temperature measurement in creep and rupture testing.

Steel

A wide range of interesting papers describing investigations of the properties to be expected of carbon and alloy steels comprised the Session on Steel on June 28.

H. A. Lequear and J. D. Lubahn of the General Electric Co. reported on the result of prestraining heat-treated Cr-Mo-V steel before conducting creep tests at 800 F. Plastic prestrains of 0.3 per cent were imposed in times of 25 days in one case and 40 min in the other. Data showed that the quickly strained specimens had about 30 times the creep rate of the slowly strained specimens. The rate history effect might be attributed to strain aging; however the direction of the effect is opposite to that

expected from earlier investigations. Interrupted creep tests failed to reveal any strain aging effect that could explain the observed rate history effect.

The effects of neutron irradiation on the mechanical properties of carbon and alloy steels were explained by R. G. Berggren and J. C. Wilson of the Oak Ridge National Laboratory. The data in this paper were obtained at relatively low levels of integrated neutron flux, and it should be emphasized that very possibly metals in future power reactors may be exposed to fluxes 100 to 1000 times greater, and effects that were unseen in the present investigation may be very important. These differences in behavior due to neutron flux exposure are believed important because they imply that the response of an irradiated metal will not be the same as an unirradiated metal to the same conditions of stress, strain, time, and temperature in service.

The shape of the stress-strain curve for austenitic stainless steels is altered, and with sufficient irradiation, or a high enough testing speed, the metals showed definite yield points. In addition, the yield stress of the irradiated austenitic stainless steels was found to depend strongly on the strain rate.

In carbon steels, irradiation sometimes eliminated the yield point and decreased the ductility to a greater extent than in austenitic stainless steels. Annealing of irradiation effects in carbon steels during irradiation at elevated temperatures was found to exert varying degrees of influence on different mechanical properties. Notch-bar impact tests on the carbon steels showed the effect of irradiation on the transition temperature.

The study of radiation effects in metals has been going on less than ten years. In view of the short time, the difficulties of experimentation, and the small number of workers it should be emphasized that we probably know very little about radiation effects in metals, and that what has appeared in the literature represents a very small part of the information that will be required when the ASTM writes its first specification on Steels for Service in Nuclear Reactors.

F. Garafola, G. V. Smith, and D. C. Marsden of the U. S. Steel Corp. Fundamental Research Lab. reported the effect of straining and aging hot-rolled low-carbon steels on their impact and tensile properties.

The maximum shift upon aging at 75 F is essentially the same for a silicon-aluminum killed steel made by liquid metal practice, a capped open-hearth steel, and a capped bessemer steel. An additional shift in the transition range is found for the bessemer steel upon ag-

ing at 450 F after fully aging at 75 F, but essentially no additional shift is found for the other two steels. After straining and aging at 75 F or 450 F for several years, the impact results do not show an over-aging effect, that is, any tendency to return to the original properties. Exposure at 900 or 1200 F after straining and fully aging at 75 F brings about a slight improvement in the notch-impact properties but no return to the original properties. Normalizing at 1650 F eliminates all strain and strain-aging effects on notch-impact transition-temperature range.

After straining and aging at 75 F for several years, no appreciable recovery in yield or tensile strength was observed. Some recovery in both was found at 450 F, but a great deal more was found at 900 and 1200 F. The degree of recovery in yield and tensile strengths differed in each case.

An investigation of the effect of composition on the microstructure and mechanical properties of 21 per cent chromium, 10 per cent nickel heat-resistant casting alloy was reported by R. J. Mangone, D. D. Burgan, and A. M. Hall of Battelle Memorial Inst.

Though essentially austenitic, the alloy can contain ferrite or sigma under certain circumstances. The probability that ferrite can be formed is increased when the chromium content is high, and the nickel content or the carbon content

low. A formula relating austenite-ferrite balance to composition was proposed. Evidence suggesting that ferrite-containing compositions are susceptible to sigma formation was given. Excess carbon is disposed as eutectic carbides; secondary carbides can be precipitated at intermediate temperatures such as 1400 to 1500 F; agglomeration and spheroidization of carbides occur at temperatures of 1900 F and above.

Data were given on room-temperature and short-time elevated-temperature tensile properties. Stress-rupture properties at 1200, 1400, and 1600 F were given. Carbon was shown to be a potent strengthener. Some data were included which support field experience that this alloy has high-temperature strength properties comparable with those of the 26 per cent chromium-12 per cent nickel casting alloy.

Excellent resistance to thermal-fatigue cracking was observed. Improvements in this property were made when the excess carbides were spheroidized by pretreatment at 1900 F. The average linear coefficient of thermal expansion between 80 and 1600 F was found to be about 10.5×10^{-6} in. per in. per deg Fahr.

D. M. Teague and S. T. Ross of the Chrysler Corp. showed some excellent micrographs of heat-treated 1087 steel

(Continued on page 19)



The Traveling Print Show from the 1954 Photographic Society of America Technical Exhibit again was a feature of the Annual Meeting. The display included photographs from a large variety of scientific fields, including biological, astronomical, and industrial photographs. A series illustrating the use of Schlieren photography was of particular interest. In the group of members studying the prints, it is not surprising that Frank Tatnall is particularly interested in one showing stress analysis using a stress coating.



R. C. Adams



B. J. Barmack



E. J. Kilcawley



R. J. McKay



W. T. Pearce

AWARDS OF MERIT

On recommendation of the Award of Merit Committee the Board of Directors conferred Awards on eleven men who have rendered distinguished service to the Society, especially along technical lines. The presentation was made at the President's Luncheon on June 28.

Under the rules of the Award of Merit each technical committee may suggest one candidate annually and the Award Committee may select nominees from other areas of the Society's work. While each of the men listed below was honored for intensive work and contributions in a specific field, each has furthered in numerous ways the general activities of the Society.

To **Robert Carson Adams, Jr.**, Superintendent, Chemical Engineering Lab., U. S. Naval Engineering Experiment Station Annapolis, in recognition of active and constructive service, especially in Committee D-19 on Industrial Water, and for consistent support of other technical, editorial, and administrative activities.

Mr. Adams has been a personal member of ASTM since 1946 and has been active on several ASTM committees and subcommittees. He was a member of Committee D-2 on Petroleum Products and Lubricants for many years and was on the group which organized Committee D-12 on Soaps and Other Detergents. As a member of Committee D-19 on Industrial Water, he was Chairman of the Editorial Committee for the *Manual on Industrial Water*. He has served on the Society's Administrative Committee on Papers and Publications.

Mr. Adams is also an active member of the American Institute of Chemical Engineers.

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To **Boris J. Barmack**, Senior Engineer, Transmission Engineering Dept., Commonwealth Edison Co., Chicago, in recognition of sustained contributions to the Society's work in Committee A-5 on Corrosion of Iron and Steel, particularly on hardware specifications, and for consistent support of other ASTM activities.

Mr. Barmack has been active in ASTM since 1930 when he became a member of Committee A-5 on Corrosion of Iron and Steel. He is also active on many of its subcommittees and has served on Committees D-7 on Wood, D-9 on Electrical Insulating Materials, and D-11 on Rubber and Rubber-Like Materials. He served as chairman of the Arrangements Committee of the Chicago District Council for the 50th Anniversary Meeting (1955) of Committee D-7 on Wood. He has also been active in the committee work of other societies, including the old National Electric Light Assn., having been chairman of its materials and equipment group.

He is a member of the American Institute of Electrical Engineers, Western Society of Engineers, and the American Wood Preservers Assn.

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To **Edward James Kilcawley**, Head, Division of Soil Mechanics and Sanitary Engineering, Rensselaer Polytechnic Institute, Troy, N. Y., in recognition of extensive and valued service to the Society, particularly in support of standardization and research work in Committee D-18 on Soils for Engineering Purposes, of which he has been Chairman since 1947.

Professor Kilcawley is a charter member of Committee D-18 on Soils for Engineering Purposes, which was

organized in 1937, and has been chairman of the committee since 1946. Through his membership in ASTM and his committee activities he has stimulated much interest and activity in the development of numerous symposiums on the subject of testing soils for engineering purposes, and in standard methods of test.

He was representative of ASTM at the Second International Conference on Soil Mechanics and Foundation Engineering at Rotterdam, Holland, in 1948.

Professor Kilcawley is a member of Sigma Xi, Chi Epsilon, Tau Beta Pi, American Society of Civil Engineers, U. S. National Council on Soil Mechanics, American Society for Engineering Education, and the American Public Health Assn.

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To **Christopher Earle Loos**, Assistant Metallurgical Engineer, Structural and Plate Bureau, U. S. Steel Corp., Pittsburgh, in recognition of significant leadership in improving specification requirements for structural steels, and for contributions to Committee A-1 on Steel and its Subcommittee II on Structural Steel.

Mr. Loos has been a member of ASTM since 1940 and has been active in Committee A-1 on Steel since 1944. As chairman of Subcommittee II on Structural Steel for Bridges, Buildings, Rolling Stock, and Ships, Mr. Loos has led in the change in method of issuing specifications, whereby the actual product specification is a very condensed document and the material common to the whole structural field is in a "general requirement" specification. Mr. Loos also has been active in other ASTM special activities, especially in the Pittsburgh area.

Other of his society affiliations in-

clude the American Welding Society, American Society for Metals, and the American Railway Engineering Assn. He is a member of Tau Beta Pi, honorary engineering society.

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To Robert James McKay (retired), Chemical Engineer, International Nickel Co., New York, in recognition of intensive interest and contributions through Committee B-8 on Electrodeposited Metallic Coatings, of which he was a Charter Member and its second chairman, and for support of ASTM corrosion work.

Mr. McKay has been a member of ASTM since 1922 and at different periods since 1923 has been active in the work of the following committees: B-2 on Non-Ferrous Metals and Alloys, B-3 on Corrosion of Non-Ferrous Metals and Alloys; B-8 on Electrodeposited Metallic Coatings; D-14 on Adhesives; E-8 on Nomenclature and Definitions; and A-5 on Corrosion of Iron and Steel. He continues active in the work of Committees A-5, B-2, B-3, and B-8. He was chairman of Committee B-8 from 1943 to 1947 and represented B-8 on the Advisory Committee on Corrosion. Mr. McKay has also been active in the New York District Council and served as a member of the New York District Committee in 1938.

He is the author of approximately 40 technical papers on Monel and high-nickel alloys, including the earliest publications on Concentration Cells in Corrosion, Welding Nickel Alloys, Nickel Clad Steel and Properties of Inconel. He is the author of the ACS monograph on Corrosion Resistance of Metals and Alloys, 1936. In addition to ASTM, Mr. McKay is a member of the American Chemical Society, Society of Chemical Industry, Electrochemical Society (past-president) and the American Electroplaters Society.

To William Tudor Pearce, Consultant on Organic Coatings, Bala Cynwyd, Pa., in recognition of long-time, constructive work in the field of paint, varnish, and related products, particularly in Committee D-1 on Paint, Varnish, Lacquer, and Related Products where he has been Chairman for over ten years, and an active worker since 1921, and for support of other ASTM activities.

Dr. Pearce has been an individual member of ASTM since 1944, but has been active in Society affairs since 1921 when he became the representative of Valentine and Co. on Committee D-1 on Paint, Varnish, Lacquer, and Related Products. He has been Chairman of Committee D-1 since 1944 and represents D-1 on the Advisory Committee on Corrosion. He has also been active in ASTM affairs as a member of the Philadelphia District Council from 1935 to 1949.

In addition to being a member of ASTM, Dr. Pearce is a member of the American Chemical Society and Sigma Xi. He is the author of many articles on research in the Journal of the American Chemical Society, Industrial and Engineering Chemistry, and the Official Digest of the Paint and Varnish Production Clubs.

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To Nathan C. Rockwood, Editor Emeritus of Rock Products Magazine, Chicago, in recognition of long and effective service to the Society, particularly in Committee C-7 on Lime, of which he is a past-chairman, and for his sustained editorial support of ASTM.

Mr. Rockwood has been a member of ASTM since 1919 and a member of Committee C-7 on Lime since 1931,

serving as chairman of the committee from 1940 to 1942. Currently, and for the past ten years, he has been chairman of Subcommittee VIII on Nomenclature, Definitions and Editorial; currently member of Subcommittee X on Hydraulic Lime; past chairman of Subcommittee I, Advisory; and has been a member of Subcommittee II on Structural Lime, III on Lime for the Chemical Industries, and IX on Research. Mr. Rockwood also has been a member of Committee E-8 on Nomenclature and Definitions since 1945 and was a member of the former Committee E-5 on Standing Committees.

In addition to ASTM he is a member of the American Institute of Mining and Metallurgical Engineers, and the American Concrete Inst. He is an honorary member of the National Lime Assn and an honorary director of the National Sand and Gravel Assn, and the National Ready Mixed Concrete Assn.

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To Robert B. Sosman, Visiting Professor of Ceramics, Rutgers Univ., New Brunswick, N. J., in recognition of outstanding contributions to ASTM work in refractories, and for sustained leadership in the technical and administrative activities of Committee C-8 on Refractories.

Dr. Sosman's memberships in, and awards by, many scientific organizations have largely been in line with the type of work broadly covered by ASTM Committee C-8 on Refractories. He is the author of several books and many technical papers (as author or joint author) and holds two U. S. Patents.



N. C. Rockwood



R. B. Sosman



G. N. Thompson



W. S. Young



W. A. Zinzow

Dr. Sosman has received many honors in his long and active career, including the presidency of the American Ceramic Society and the Washington Academy of Science. He is a member of numerous societies related to the ceramic, chemical, and metallurgical fields.

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To **George N. Thompson**, Asst. Chief, Building Technology Div., National Bureau of Standards, in recognition of longtime and distinguished service, particularly in Committee E-5 on Fire Tests of Materials and Construction, for his interest in standards in building codes, and for support of other ASTM activities.

Mr. Thompson has been a member of ASTM since 1932 and a member of Committee E-5 on Fire Tests of Materials and Construction for the same period. He has served, since 1938, as chairman of Subcommittee I on Standard Specifications for Fire Tests of Materials and Construction of Committee E-5. He was formerly chairman of Subcommittee V on Nomenclature and Definitions and is currently a member of the Advisory Group and of Subcommittee III on Fire Tests of Wall Opening Assemblies and Subcommittee IV on Fire Tests of Acoustical and Similar Finishes. From 1938 to 1942, Mr. Thompson served as representative of the former Committee C-5 (now E-5) on Committee E-8 on Nomenclature and Definitions and also represented C-5 on Committee E-1 on Methods of Testing. He also served on the Administrative Committee on Ultimate Consumer Goods, 1946 to 1947.

Mr. Thompson is known internationally as an authority on engineering and safety codes. He is considered to be not only a leading authority in his chosen field but one of the prime movers in the formulation of standards and codes in this country. He is the author of numerous papers on building code problems.

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To **William S. Young**, Section Head, Research Div., Atlantic Refining Co., in recognition of notable, constructive service to the Society in the establishment of ASTM Committees on Absorption Spectroscopy and Mass Spectrometry, in both of which he has been an officer and contributed much time and effort.

Dr. Young has been active in ASTM Committee work since 1949. He has served on several subcommittees of ASTM Committee D-2 on

Petroleum Products and Lubricants, currently being a member of Section J of Research Division IV. He was a member of the joint committee on Chemical Analysis by Powder Diffraction Methods from 1951 to 1954 as representative of Committee D-2. He was secretary of Committee E-13 on Absorption Spectroscopy from 1950 to 1954. He has been chairman of Committee E-14 on Mass Spectrometry since 1952 when the committee was organized.

In addition to ASTM, Dr. Young is a member of the American Chemical Society, the American Petroleum Institute, Sigma Xi, and Alpha Chi Sigma.

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To **William A. Zinzow**, Asst. Director of Development, Bakelite Co., Bound Brook, N. J., in recognition of sustained support of ASTM technical and administrative work, particularly in Committees D-9 on Electrical Insulating Materials and D-11 on Plastics, where his outstanding technical knowledge and human understanding have been so effective.

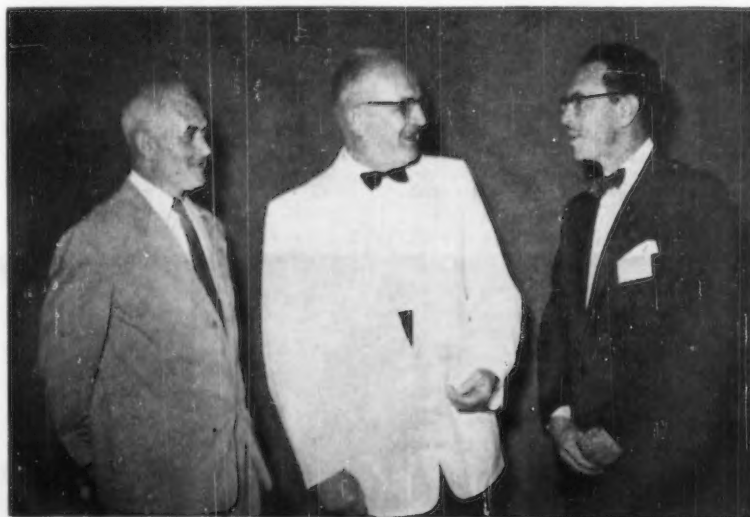
Mr. Zinzow began his ASTM activity as a member of Committee D-9 on Electrical Insulating Materials in

1934 and became an individual member of the Society in 1936. He has been a member of Committee D-20 on Plastics since 1937. He was vice-chairman of Committee D-9 from 1952 to 1954 and secretary from 1942 to 1948. Currently he holds active membership in many subcommittees of Committees D-9, D-20, and E-1 on Methods of Testing, of which he has been a member since 1940. He is also a member of Committee D-11 on Rubber and Rubber-Like Materials.

Mr. Zinzow served as a member of the Board of Directors from 1945 to 1948 and has been a member of the Administrative Committee on Standards since 1950. He has made a number of contributions to ASTM publications.

In addition to ASTM, Mr. Zinzow is currently active in the work of Technical Committee 61 on Plastics of the International Standards Organization and represented the American group at the meetings in New York and Turin, in 1952. He is a member of the ASA-ASTM Joint Standards Board and Chairman-Leader of the ASA Working Group on Thermal Properties.

Mr. Zinzow is also a member of the American Physical Society, the American Ordnance Assn., and the American Optical Society.



New President C. H. Fellows, center, and Director F. L. LaQue, left, in a discussion with C. H. Sample, Chairman of Committee B-8.

Sessions

at 30,000 \times using an improved technique to delineate very fine structures. The precipitation and orientation of epsilon carbide and its subsequent transformation to larger cementite particles was shown as a function of heat treating temperature and time.

Fatigue

Three sessions were devoted to 13 papers on the subject of fatigue, one on June 30 and the other two on July 1. Attendance at all the sessions was large, and response to the papers in the form of discussion was very gratifying to the authors.

R. G. Crum and E. D'Appolonia of the Carnegie Inst. of Technology gave an excellent series of observations on the mechanism of fatigue damage, using titanium alloy Ti-75A. The investigation was primarily concerned with fatigue failures in the upper stress range. Tests were conducted at speeds ranging from 30 to 10,000 rpm with and without coolant.

Damping, stress-strain, and failure properties under increasing stress amplitude of 1020 steel, 24-ST4 aluminum, 4340 steel and RC-55 titanium were investigated by F. H. Vitovec and B. J. Lazan of the University of Minnesota and related to conventionally determined fatigue strength. Test results also indicated that the Prot fatigue method indicates conventional fatigue strength with a reliability of 10 per cent.

J. C. Levy and G. M. Sinclair reported that low-carbon steel exhibits considerably greater fatigue life at temperatures of 400 to 500 F than at room temperatures. This increase can be attributed to the presence of carbon and nitrogen in the metal and could be classified as strain aging. A recently developed theory of strain aging was applied, and calculated values of the peaking temperature agreed well with the observed values of 400 to 500 F.

Rotating-beam tests of a heat-treated 4340 steel were reported by H. E. Frankel and J. A. Bennett of the Bureau of Standards. These indicated that fatigue life can be increased by applying a large number of cycles at each of a series of stresses of increasing amplitude (coaxing). The damaging effect of fatigue stressing 10 per cent above the fatigue limit was eliminated by understressing and coaxing, but damage produced by a stress 30 per cent above the fatigue limit was not completely eliminated.

A. W. Demmler, Jr., M. J. Sinnott, and L. Thomassen of the University of

Michigan presented a series of conclusions on the influence of surface preparation and treatment on the fatigue life of some titanium alloys. Except for shot peening and grinding, the influence of the method of surface preparation on fatigue properties is not marked. Shot peening improves fatigue life, particularly at the higher stresses, while grinding with the type abrasive used definitely decreased fatigue life.

Another investigation into the fatigue life of titanium alloys was reported by J. G. Kaufman, Aluminum Co. of America, and E. D'Appolonia, Carnegie Institute of Technology. Conclusions drawn from this study included a beneficial effect on the endurance limit of unnotched RC-55 titanium alloy specimens when torsional prestrain is applied. Use of a coolant raises the endurance limit of prestrained specimens but does not decrease the difference between the endurance limits of tensile and torsional prestrained specimens.

G. R. Gohn and J. P. Guerard of Bell Telephone Laboratories, and H. S. Freynik of Riverside Metal Co. gave the results of the first portion of a systematic study of the mechanical properties of phosphor bronze alloys in the form of cold-rolled strip. The study indicates that optimum fatigue properties of any temper of phosphor bronze cold rolled after a 0.035 mm grain size anneal are obtained with 5 per cent tin. When grain size is reduced to 0.015 mm, optimum fatigue properties are obtained with 4 per cent tin for all tempers except annealed, where 5 per cent ap-

pears better. There appears to be no justification from a fatigue standpoint for adding more than 5 per cent of tin. When the tin content is 5 per cent or more, fatigue properties are not improved by cold rolling provided the grain size is small. For tin contents of 3 per cent or less, no significant improvement in fatigue strengths is obtained by cold rolling the various alloys more than 50 per cent (extra-hard temper). For tin contents of 4 per cent or more, no significant improvement in fatigue strength is obtained by cold rolling the various alloys more than 37.4 per cent (hard temper). In the 3, 4, and 5 per cent tin alloys, increasing the phosphorus content from 0.05 to 0.40 per cent improves the fatigue strength of all tempers. The effect of an increase in phosphorus content on fatigue is most pronounced in the case of the annealed tempers of the three alloys studied and on the rolled tempers of the 3 per cent tin alloy.

It would appear from a study of the fatigue properties that alloys containing 3, 4, and 5 per cent tin have distinctly different characteristics, the 3 and 5 per cent alloys being somewhat similar. The composition limits, therefore, should be set on a somewhat narrower base than that now used in ASTM Specifications B 103.

A paper on the effect of alloy content on the metallographic changes accompanying fatigue was given by M. S. Hunter and W. G. Fricke, Jr., of the Aluminum Research Laboratories. This investigation seems to indicate that the additions of alloying elements to aluminum, as typified by additions of magnesium, bring about pronounced changes in the surface deformation and crack configuration resulting from cyclic loading. With unalloyed aluminum, most areas of a specimen behave similarly and extensive deformation and cracking take place before failure. With alloys, a smaller proportion of the grains are visibly affected by fatigue, the amount of slip deformation is decreased, although initial slip is observed after a smaller number of cycles, a smaller percentage of the slip bands which form reach the cracking stage, and fewer of the cracks which form leave the confines of the parent grain. With alloys, the changes in surface features are highly localized with the result that certain areas may show extensive change while adjoining areas appear to be unaffected. Thus, it appears that while alloying additions increase static strength, they make fatigue an increasingly localized phenomenon, and, therefore, that it is localized weakness rather than over-

Thanks Again to the Philadelphia District

Once again the Society is indebted to the members of the Philadelphia District who acted as hosts to the members in Atlantic City.

Active in planning and carrying through entertainment details were the District officers, headed by E. K. Spring, Henry Disston and Sons, Inc., with Vice-Chairman Tinius Olsen, 2nd, Tinius Olsen Testing Machine Co., and Secretary A. H. Kidder, Philadelphia Electric Co. Mr. Olsen was Chairman of the Ladies' Entertainment Committee. E. J. Albert, Thwing-Albert Instrument Co., was in charge of the dinner and entertainment.

President's Luncheon guests had an opportunity to express their thanks to the District officers when the chairman called on them during the Luncheon program.

all strength which controls fatigue behavior.

F. M. Howell and J. L. Miller of the Aluminum Research Laboratories presented data obtained from an investigation of the axial stress fatigue strengths of several structural aluminum alloys. With the proper selection of stress ratios and through the use of scatter bands and modified Goodman diagrams, a basis has been provided for final tabulation of average or typical axial stress fatigue strengths. By this means, typical fatigue strengths pertaining to various conditions of stress ratio, minimum stress, and mean stress have been determined for the more important structural aluminum alloys.

A paper by Ch. Massonnet of Liege University was presented by title only but will be published later. This investigation covered the effect of size and shape of the specimen, the shape of notch and grain size of the metal on the strength of smooth and notched specimens of medium carbon steel. The paper shows conclusively an important size effect in rotative flexure, provides curves for designing machine parts of medium carbon steel, emphasizes that grain size is very important in consideration of notch sensitivity, and points out that stress gradient has an appreciable effect on fatigue resistance.

W. N. Findley, Brown University, and P. N. Mathur, Ford Motor Co., have studied the anisotropy of fatigue strength of 4340 steel and 25S-T6 and 76S-T61 aluminum alloys in bending and torsion. The influence of anisotropy on the fatigue strength of metals is not independent of the state of stress in bending and torsion. Consequently, the classical theories for combined stress fatigue based on linear superposition of stress fields in bending and torsion warrant a correction for anisotropy. The results of fatigue tests may be explained by the concept that the cyclic principal shear stress is primarily responsible for fatigue, but the ability of anisotropic materials to withstand the action of cyclic shear stress is influenced by the magnitude and sign of the complementary normal stress.

The behavior of long helical springs under fluctuating loads was described by C. L. Staugaitis and H. C. Burnett of the National Bureau of Standards. The fatigue life of long springs operating on a guide rod was reported considerably shorter than that for short springs, an important cause being wear due to the guide rod. Lubrication with dry molybdenum disulfide improved the fatigue life of long springs operating at stress ranges below 150,000 psi.

J. A. Bennett, National Bureau of Standards, showed that HAE coating on

magnesium alloy AZ31X reduced the fatigue life to a somewhat greater extent than would be expected when assuming the coating has no strength. The coating in most cases provided sufficient protection so that the fatigue resistance of the specimens was not decreased by exposure to salt spray.

Non-Ferrous Metals

The non-ferrous metals session was opened with a paper by Ward Paxson, *et al* on the Mechanical Properties of a Magnesium Alloy by Biaxial Tension at Low Temperatures. They found the magnesium alloy (FS1-H24) to be considerably less ductile under biaxial tension than under simple tension. For the range of temperatures considered (-100 to $+80$ F) the ductility in simple tension decreased with decrease in temperature. However, the ductility under balanced biaxial tension was not affected by changes in temperature.

W. M. Baldwin, Jr. and G. S. Sangdahl, Jr., in their tests on the strength of bent copper tube showed that the bursting strength is increased in the bend; also, failure in bursting tests always occurs close to the neutral axis of the bend indicating that the most severely strained and thinnest section of the bent tube is not the weakest section.

Paul Shashinian and Joseph R. Lane concluded in their paper on Effect of Specimen Dimensions on High-Temperature Mechanical Properties that changes in cross-sectional area, gage length, and length-to-diameter ratio affect the properties of S-816 and Monel to different degrees and sometimes in a different manner. Variations are small if the ratio of length to diameter is kept constant.

Considerable discussion resulted from G. R. Gohn's presentation of his paper A Hardness Conversion Table for Copper-Beryllium Alloy Strip. Conversion tables for Rockwell B, Rockwell Superficial 30 T, and Diamond Pyramid hardness were presented for material in the as-rolled condition and Rockwell C, Rockwell Superficial 30 N, and Diamond Pyramid values for the same material precipitation hardened at 600 F. Thickness of strip ranged from 0.010 to 0.064 in.

Atmospheric Corrosion of Non-Ferrous Metals

Supplementing the Symposium on Atmospheric Exposure Tests on Non-Ferrous Metals presented at the Spring Meeting in 1946, and culminating the 20-year tests on a number of non-ferrous metal alloys, ASTM Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys sponsored a two-session Symposium on Atmospheric Corrosion of Non-Ferrous Metals.

The paper by Walton and King discussed the aluminum phase of this work and concluded that in all environments the rate of attack on aluminum alloys, especially penetration of attack, decreases markedly with time. By virtue of comparative data, equally good performance may be expected from a variety of newer aluminum alloys which have been developed to impart strength, weldability, etc., along with good resistance to corrosion.

The ASTM data on aluminum were supplemented with the results obtained by Reinhart and Ellinger on tests conducted by the National Bureau of Standards at Coco Solo, Canal Zone; Norfolk Va.; and Washington, D. C. These tests began in 1932 and included all of the then current structural alloys of aluminum, together with some experimental alloys which had shown promise for future aircraft applications. Aluminum alloys containing magnesium, manganese or cadmium, or clad alloys containing copper were the most corrosion resistant in urban and marine atmospheres while an alloy containing copper, manganese, and silicon was the least resistant. Anodically formed inorganic surface coatings are more protective than coatings formed by simple immersion in chemical solutions.

A. W. Tracy, who presented the results of the 10-yr exposure in the earlier symposium, discussed the effect of various atmospheres on copper alloys after twenty years. The effect of pitting was negligible, and in general corrosion rates were highest in industrial atmospheres, averaging less than 0.1 mil per year; in rural atmospheres averaging less than 0.025 mil per year.

In a similar paper, Tracy, *et al*, described the effect of atmospheric corrosion on eleven brands of copper in sheet and wire form exposed at four Connecticut locations. It was found that the purest copper corroded least and arsenical copper the most. The difference is not believed to be of practical significance.

Two papers dealt with the galvanic corrosion tests sponsored by Committee B-3. The first, presented by Teeple, discussed the results to date of the disk-type phase of magnesium couple program initiated in 1949. In general, the aluminum alloys contributed less to the net weight losses of the magnesium alloys than any of the other cathodic materials tested. Carbon steel showed the greatest effect on the weight loss of magnesium with red brass and Monel showing slightly less effect.

A similar paper prepared by Compton and Mendizza described the bolt and

(Continued on page 22)

MEDALS AND AWARDS



W. G. Fricke, Jr. M. S. Hunter

RICHARD L. TEMPLIN AWARD

The purpose of this award is to stimulate research in the development of testing methods and apparatus, to encourage the presentation to the Society of papers describing new and useful testing procedures and apparatus, and to recognize meritorious efforts of this kind.

● 1955 award to M. Scott Hunter and William G. Fricke, Jr., Aluminum Research Laboratories, Aluminum Company of America, New Kensington, Pa., for their paper, *The Metallographic Aspects of Fatigue Behavior*.

M. Scott Hunter, Assistant Chief of the Metallography Division, is a graduate of Amherst College and Carnegie Institute of Technology, receiving the degree of M. S. in Metallurgical Engineering in 1934. At Alcoa since 1934, his work has dealt with investigations of the microscopic and submicroscopic characteristics of aluminum, the nature and mechanism of formation of naturally and artificially formed films on aluminum and aluminum alloys, and the application of metallographic techniques to the investigation of metal behavior.

William G. Fricke, Jr., Research Metallurgist, received a B. S. degree in 1951 from The Pennsylvania State University. With Alcoa since 1952, his work has been concerned primarily with the application of metallographic techniques in an investigation of the fundamental mechanism of the behavior of metals under repeated loading and the relationship of microscopic and submicroscopic structural changes to the ultimate fatigue behavior of aluminum.

SANFORD E. THOMPSON AWARD

This award was established by Committee C-9 on Concrete and Concrete Aggregates in recognition of a paper of outstanding merit on concrete and concrete aggregates.

● 1955 award to R. C. Mielenz for his paper, *Petrographic Examination of Concrete Aggregates*.

Richard C. Mielenz, Head, Petrographic Laboratory, U. S. Bureau of Reclamation, Denver has been a member of ASTM since 1948 and has been active in the work of Committees C-9, D-18 on Soils for Engineering Purposes, E-8 on Nomenclature and Definitions, sections of E-1 on Methods of Testing, and the Joint Committee on Chemical Analysis by Powder Diffraction Methods. This is the third time he has won the Thompson Award.



R. C. Mielenz

J. A. Bishop

H. G. Mason

L. A. Palmer



C. A. HOGENTOGLER AWARD

This award, established in 1954 by Committee D-18 on Soils for Engineering Purposes to honor its first chairman, C. A. Hogentogler, is presented for a paper of outstanding merit on soils for engineering purposes.

● 1955 award to H. G. Mason, J. A. Bishop, P. E. Brown, and L. A. Palmer for their two-part paper, *Piles Subjected to Lateral Thrust*.

H. G. Mason and J. A. Bishop, U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Huene, Calif. were responsible for

Part I of the paper entitled "Measurement of Earth Pressure and Deflection Along the Embedded Portion of a 40-ft Steel Pile."

P. E. Brown and L. A. Palmer, Bureau of Yards and Docks, Department of the Navy, Washington, D. C. contributed Part II of the paper, entitled "Analysis of Pressure Deflection, Moment, and Shear by the Method of Difference Equations."

MAX HECHT AWARD

This award was established in 1954 by Committee D-19 on Industrial Water in honor of its first chairman and is given in recognition of outstanding service to the committee in the advancement of its objective—the study of water as an engineering material.

● 1955 award to Everett P. Partridge, Director, Hall Laboratories, Inc., Pittsburgh, Pa.

E. P. Partridge has made outstanding contributions to the knowledge of the properties and physical chemistry of the formation of boiler scale, the concept of steam blanketing to explain unusual occurrences of internal attack in boiler tubes, water treatments, corrosion and cracking in boiler steel, crystal forms of calcium sulfate, and experiences with gadgets sold for industrial water conditioning. He has been a member of Committee D-19 since 1932 and has served as chairman of the Joint Research Committee on Boiler Feedwater Studies, in addition to many other technical committee activities.



E. P. Partridge

(Continued from page 20)

Sessions

wire type couple program which has been completed. The authors have concluded that the reproducibility of the bolt and wire type couple data is consistent with that of other types of galvanic couples. They have also concluded that the differences in corrosivity of atmospheres, the different times, and the different seasons must be considered when the tests are of short duration.

It is of interest that E. A. Anderson presented both the earlier 10-yr results and the present 20-yr results of the rolled zinc tests. His paper indicated that the corrosion rate of zinc is lowest in dry, pure atmospheres and highest in industrial atmospheres. Marine locations where the specimens are not in direct contact with salt spray are mildly corrosive. Exposure of premachined tension test specimens is useful only in determining edge effects. The corrosion rate of zinc in the atmosphere is essentially constant with time.

The use of lead and tin outdoors was discussed in a paper by Minarcik and Hiers. The tests on lead indicated this material to be very durable at all of the test sites. In industrial and sea coast exposures tin is less corrosion resistant. The storage specimens showed that the lead alloys lost approximately 13 per cent of their original strength while the tin lost approximately 18 per cent.

Copson concluded in his paper that nickel and high-nickel alloys are very resistant to corrosion at marine and rural locations. In severe industrial locations the corrosion is more pronounced. In alloys containing appreciable amounts of chromium, the attack is local and of a pitting type. He also discussed the behavior of nickel-copper alloys and a nickel-iron series containing up to 20 per cent iron.

Impact Testing

Two sessions, the first and second, were devoted to the Symposium on Impact Testing. This was sponsored by the Impact Committee of Committee E-1 on Methods of Testing in recognition of developing more fundamental information with respect to the test. Despite the fact that this is one of the oldest types of test studied, there is still much that is obscure. The present symposium encompasses descriptions of impact on parts, components, and complete structures and is not confined to the more usual notched bar testing. This broadened scope was undertaken for the purpose of enhancing the practical application of the impact test and of testing at high strain rates. Several papers, however, were devoted

to the discussion of notched bar testing in order to lay the ground work for subsequent discussions. In all, the following papers were presented:

Notched-Bar Testing—Theory and Practice—S. L. Hoyt

Transition Behavior in V-Notch Charpy Slow Bend and Impact Tests—Carl E. Hartbower

Reproducibility of Charpy Impact Testing—David E. Driscoll

Automatic Impact Testing to -236°C—Thomas S. DeSisto

The Influence of Pendulum Flexibilities on Impact Energy Measurements—J. I. Blum

The Impact Tube: A New Experimental Technique for Applying Impulse Loads—George Gerard

Longitudinal Impact Tests of Long Bars with a Slingshot Machine—W. Ramberg and L. K. Irwin

Shock Tester for Shipping Containers—W. H. Cross and Max McWhirter

Properties of Concrete at High Rates of Loading—D. Watstein

Speed of Testing

The Symposium on Speed of Testing was in a sense an extension of the discussion on impact testing—some of the papers covering extreme rates of loading. The paper by H. F. Schiefer, J. C. Smith, F. L. McCrackin, and W. K. Stone, for example, on the Stress-Strain Relationships in Yarns Subjected to Rapid Impact Loading, reviewed the information obtained from high-speed motion picture photography of textile yarns subjected to high-speed impact in a longitudinal and a transverse direction. This work was sponsored by the Quartermaster General as a part of a fundamental test program on textile materials for military use. The authors tested five types of yarn and graphically illustrated the rate of straining and load-elongation as a function of the type of loading. The effect of rate of strain is important in parachute shroud lines, high-speed textile fabrication machines, safety nets, aircraft tire cord and the like.

The Effects of Speed in Plastics Testing, discussed by A. G. H. Dietz and F. J. McGarry, were approached by considerations of both destructive and non-destructive testing. In these categories the authors considered long-time tests, static type tests, and rapid (impact) tests. Each of these test programs was discussed in the light of modern instrumentation and theory with a view to the progressive improvement of test techniques.

The variations expected in a paper testing program were illustrated by R. E. Green in his paper Effect of Speed of Testing on Tensile Strength and Elongation of Paper. Green used five different types of paper for his test series. Using ten specimens for each type of paper, at five different speeds,

the author concluded that tensile strength increases with increased speed of testing. Elongation of the paper samples, using a similar test program, showed no significant trend in any direction.

In the earliest stages of wood testing research it became evident that strength values were influenced by the rate of load testing. L. J. Markwardt and J. A. Liska, in their paper, The Influence of Rate of Loading on the Strength of Wood and Wood-Base Materials, have summarized recent data supplementing the information which they presented at the last ASTM Speed of Testing Symposium. The authors conducted a series of tests utilizing two softwood and two hardwood species which were used to evaluate the effect of rapid loading on the compressive and flexural strength properties of wood. The basic procedure for this series of tests was the Standard Methods of Testing Small Clear Specimens of Timber (D 143-52). The procedures used, however, were modified to permit faster rates of loading and special testing machines to apply and record high rates of load deflection and deformation of the wood specimens.

D. McHenry and S. S. Shideler reviewed the extent to which specifications in the field of speed of testing have been applied to concrete, in their paper, Effect of Speed in Mechanical Testing of Concrete. The authors found that the strength in compression and flexure and modulus of elasticity appear to increase with loading rate. The authors' work shows that the compression, flexure, and modulus of rupture tests are not particularly sensitive to rate of loading, but that this field has not yet been thoroughly investigated.

H. N. Ritland, in his paper, The Effect of Speed of Testing on Glass, discussed two general types of time-dependent phenomena which affect glass testing procedures. The first type was time-dependent because changes in the fundamental atomic or molecular arrangement in the glass proceed at finite rates during the test so the property being measured varies with time; these processes occur primarily at the annealing temperature although their effects are present also at lower temperatures through the dependence of the physical properties of the glass on its thermal history. The second type included the reaction of glass to an externally applied stress which is time dependent due to a process such as viscous flow or crack growth of flaws (stress concentration) which is the governing factor in speed of testing glass. The author included the important subject of the effect of time on the breaking strength of glass.

D. C. Scott and D. S. Villars in their paper, Effect of Speed of Testing and Tensile Test of Elastomers and Hard Rubber, show that low testing speeds have little effect on elastic materials. At high speeds, elastic materials fall into two classes: those that crystallize, and those that do not crystallize. In the first case, tensile strength is independent of speed until the speed exceeds the rate of crystallization, after which point there is a drop in tensile strength. The noncrystallizing materials evidence increased tensile strength with increased speed even at low speeds. The authors reviewed significant work in this field and indicated the advisability of further investigation of elastomeric materials.

G. Rugger used a special modification of an Instron testing machine to provide constant strain on the plastic specimen. In his paper, Constant Strain Rate Tests of Plastics, the author indicated that data derived from a constant rate of strain instrument are more reproducible and more precise. The more accurate data would require less testing and thus reduce testing costs. The author indicated that further work is to be undertaken.

Testing

Several different aspects of the constant problems which arise in testing materials were contained in four papers presented at the Session on Testing on June 27.

A remotely operated extensometer to facilitate strain measurements on highly radioactive specimens was described by R. G. Berggren and J. C. Wilson of the Oak Ridge National Laboratory. Although developed specifically for this purpose, several features are of potential value in conventional tension testing. The extensometer mounted on a grip or crosshead is always ready for use and may be applied to and removed from the specimen at any time during the test. It is adaptable to a variety of specimen shapes and sizes without modification. All strain magnification is obtained electronically, resulting in considerable flexibility of operation as regards magnification and range changes during the course of a test or before the start of a test. The extensometer also has a long range with high magnification. A last factor, often important to the experimenter, is that the instrumentation can be assembled from readily available components.

For many years the materials testing engineer has been intrigued by the possibility that creep tests and tension tests can be related to one another. One of several concepts which has received considerable attention is called

"plastic ideality." According to this concept, the plastic deformation behavior depends only on current conditions and not on the past history of the deformation. An investigation by H. A. Lequear and J. D. Lubahn of the General Electric Co. extended earlier work to cover the range of strains up to necking (30 per cent) and showed that tension and transient test data do permit the calculation of room temperature creep curves of copper.

Current procedures for establishing true stress-strain curves, even under conventional testing conditions, are moderately time consuming. G. W. Powell, E. R. Marshall, and W. A.

the tensile stress-strain behavior in a test completed in a few milliseconds from no load to fracture. The device could not be practically designed for constant rate of load, strain or crosshead motion, but under certain test conditions, reasonable approximations to one of these three may be approached. However, the total time interval for the test can be varied over fairly wide limits.

Electron Microstructure of Metals

Six short papers covering investigation of metal structures with the electron microscope were presented on June 29.

D. M. Teague and S. T. Ross of the Chrysler Corp. showed some excellent micrographs of heat-treated SAE 1087 steel at 30,000 \times using an improved technique to delineate very fine structures. The precipitation and orientation of epsilon carbide and its subsequent transformation to larger cementite particles was shown as a function of heat treating temperature and time.

An electron diffraction study by A. E. Austin and C. M. Schwartz of Battelle Memorial Institute indicated that epsilon carbide forms first when eutectoid steel is given an isothermal treatment at 450 F, followed by the appearance of some cementite. Evidence was found of a transition phase in the decomposition of quenched martensite. Tempering at 250 F produced epsilon carbide together with the new transition phase, whereas tempering at 300 F produces only epsilon carbide.

Results of the X-ray diffraction measurement of phases in low-temperature tempered martensite in plain carbon steels were given by W. L. Grube and D. P. Koistinen of General Motors. Quantitative measurements of retained austenite in as-quenched specimens and in quenched-and-tempered specimens up to 400 F were included. Associated data on martensite and austenite lattice parameter measurements were also presented.

R. M. Fisher of the U. S. Steel Corp. Fundamental Research Laboratory, using extraction replicas under the electron microscope, showed that in eutectoid carbon steel the first stage of tempering is completed in 5 sec at 600 F and in about 1½ hr at 400 F.

The use of electrolytic etching in studies of the distribution of the intermetallic γ' phase in titanium-aluminum hardened nickel base alloys was described by W. C. Bigelow and J. A. Any of the University of Michigan.

September 1—Last Day for Annual Meeting Papers Discussion

WRITTEN discussion of papers and reports presented at the Annual Meeting will be received by the Committee on Papers and Publications until September 1. In view of the fact that much of the discussion published in the *Proceedings* is submitted after the meeting by letter, it will be helpful if all who can will send in their discussion to Headquarters well in advance of this date so that additional time is available to review and refer the discussion to authors for closure.

Backofen of the Massachusetts Institute of Technology described a diameter gage and dynamometer constructed for testing austenitic stainless steel at various constant true strain rates from approximately 0.0006 to 0.600 per min and over a wide temperature range from room temperature downward. The basic design is sufficiently versatile that application could be made to other testing conditions.

Plastics are attractive for many applications involving large accelerations because the low specific gravity of most plastics reduces the total energy required to achieve such accelerations. It is necessary, however, to know something of the mechanical properties of the plastic under high accelerations. James Dorsey, F. J. McGarry, and A. J. H. Dietz, Massachusetts Institute of Technology, described a high-speed tension testing device for determining

A reagent consisting of 5 ml hydrofluoric acid (40 per cent) 10 ml glycerol, 10 to 50 ml ethyl alcohol, and water to make 100 total ml produced a preferential attack permitting the γ' particles to be distinguished by electron microscopy from particles of carbide and nitride phases which are also present.

A very sensitive method for identifying and studying minor phases in alloy systems was described by W. C. Bigelow, L. O. Brockway, and J. W. Freeman of the University of Michigan. This method has been adapted to the complex heat resistant alloys.

Soils

A group of five papers not confined to any one particular phase of soil testing was included in the session on Soils for Engineering Purposes held Monday afternoon, with K. B. Woods, Purdue University, presiding.

The leadoff paper, by R. K. Bernhard and M. Chasek, Rutgers University, dealt with Soil Density Determination By Direct Transmission of Gamma Rays. This paper, represents a continuation of the work of Professor Bernhard in the very interesting field of dynamic properties of soils, in which non-destructive testing by use of modern radioactive materials has been found very useful in soils testing. Fourteen different soils were investigated under various compaction and moisture conditions using a radiation source of irradiated cobalt 60 and a radiation detector. Both laboratory and field tests were described, from which the authors were able to prepare a statistical analysis of the data which provide numerical values for density equations comprising the wet soil density as an unknown variable, the transmitted radiation energy as an observed variate, and the distance between radiation source and detector as an arbitrarily selected variable. It was established that the wet soil density is inversely proportional to the logarithm of the transmitted radiation energy.

Pressure Distribution Along Friction Piles was the title of the second paper prepared by L. C. Reese, Mississippi State College, and H. B. Seed, University of California. On the basis that the supporting capacity of a friction pile driven into saturated clay appears to be determined mainly by the strength of the clay surrounding the pile, the authors described an investigation of the pressures developed at the wall of a pile driven into clay and presented theories for the analysis of these pressures. Several 6-in diameter pipe piles, 20 to 22 ft long, were driven about 15 ft into a stratum of soft, saturated clay. Electric

strain gages were installed on one pile to measure load and pressure distribution along the pile. Several borings were also put down in the test area and undisturbed soil samples were obtained. The main conclusions resulting from the investigation, even though determined from the study of a small-sized displacement-type friction pile driven into a saturated clay of low sensitivity, are considered to apply to other displacement-type friction piles driven into saturated clay. It was found that the rate of increase in bearing capacity of the pile and in shear strength of the soil adjacent to the pile were in good agreement with the rate of decrease in excess hydrostatic pressure in the soil adjacent to the pile wall. The initial effective pressures in the soil around the driven pile were in good agreement with values determined from the results of consolidation tests on partially remolded soil. Pressures were created in the soil, detectable as far away as 15 diameters, by the driving of 6-in. diameter friction piles into soft silty clay. The values for the effective lateral pressures acting on the wall of the pile at the end of the test period, as determined by the pressure measurements, were much lower than the gross effective overburden pressures in the soil.

The Relation Between Soil Moisture Tension and the Consistency Limits of Soils was the subject of a paper by R. L. Rollins and D. T. Davison, Iowa State College. One of the principal disadvantages of procedures currently available for determining consistency limits of soils, such as defined by Atterburg, has been the time-consuming factor in completing such tests. The authors described a method for estimating the consistency limits by relating them to soil moisture tension values determined by porous plate equipment and pressure membrane apparatus. Data were presented covering these relationships on soils in the textural groups of silty loam, silty clay loam, silty clay, and clay. A total of 56 different soils were used. The results of this study led to the conclusions that (1) if the textural classification of a soil is known, the consistency limits can be estimated by assuming them equal to the moisture content corresponding to a certain soil moisture tension, and (2) the establishment of actual values of soil moisture tensions in terms of water pressure for both liquid limit and plastic limit, which approximate the consistency limits.

Protective filters are often used in the foundation soils of engineering structures to allow drainage and to prevent erosion or uplift pressure from seepage water. It is important that the gradation of the filter materials be carefully

selected with respect to the gradation of the base materials. A paper by K. P. Karpoff, Bureau of Reclamation, was presented at this session, on The Use of Laboratory Tests to Develop Design Criteria for Protective Filters. The apparatus designed and used in this testing program consisted essentially of transparent plastic cylinders, 8 in. in diameter, bolted together and connected to a water supply system. Layers with different gradations of base and filter materials were compacted in the cylinders and subjected to hydraulic heads ranging from 2 to 30 ft. The physical characteristics of each material were analyzed as part of the study. It was felt by the author that one of the objectives of the research program, the development of apparatus and procedure for the determination of suitable criteria for the design of protective filters, had been adequately achieved. Results of the study are therefore considered useful in particular field problems and will permit realistic recommendations. It is concluded that a good filter material should satisfy four main requirements, which briefly are: (1) filter material should be more pervious than the base material; (2) the voids between the filter particles must be small enough to prevent base material particles from penetrating into the filter; (3) the filter system must be sufficiently thick so as to act as an insulator for the base material where frost action is involved; and (4) the size of the perforation or slot openings in drain pipe should be made with consideration of the gradation of filter material to prevent movement of particles into the pipe. Recommended gradation ranges were given for different types of particles.

The final paper in the session, entitled Some Laboratory Tests for The Evaluation of Stabilized Soils, was presented by title only in the absence of the authors T. Y. Chu and D. T. Davidson, Iowa State College.

An additional paper in the field of soils testing was presented before Committee D-18 on Soils for Engineering Purposes on Wednesday afternoon. This paper, entitled "The Relationship Between Water Content and the Accuracy With Which in-Place Densities of Sands May Be Furnished" was prepared and given by Donald F. Griffin, University of Southern California. With more and more structures being built on sand, the desirability of being able to measure accurately the in-place density of sand is becoming increasingly important. A new method for calibrating a sand funnel used to determine the volume of a cavity is presented as well as a new application of the alcohol-ether

displacement method for determining water contents.

The author concluded that calibrating a sand funnel by plotting the weight of sand leaving funnel both for a zero volume of cavity and a cavity of the capacity of the sand jug appears to be a direct, simple, and accurate method. He also concluded that the method of displacing water with alcohol which in turn is displaced by ether, assisted by a vacuum-air pressure differential, was especially suited for this research project. Moisture in sands definitely affected the accuracy with which in-place densities of sands can be measured.

Judgment Factors in Soils Testing

Committee D-18 on Soils for Engineering Purposes took a good critical look at its history and its work by means of a special symposium session at which four papers were presented by the chairman, Prof. E. J. Kilcawley, and three longtime members of the committee, Prof. D. M. Burmister, Prof. K. B. Woods, and A. E. Cummings. The papers reviewed the history of the committee since its start in 1936 (following the First International Conference on Soil Mechanics and Foundation Engineering at Harvard University), and the work which it has accomplished since that time. Frank discussion suggested that the number of test methods actually developed by the committee has been disappointing, especially when contrasted with the interest shown at its regular meetings, and by the many symposiums which it has sponsored at successive ASTM meetings. Criticisms of its work were grouped into those from engineers who consider that soil mechanics is still in too fluid a state to warrant any standard methods for soil testing, and those who consider that any standard methods of soil testing must be related with design requirements if they are to be effective.

There was agreement that there was some justification for both types of criticism but discussion from the floor stressed the urgent need for more standards for test methods, despite all the difficulties, in view of the fact that many testing laboratories have got to carry out regular soil tests in connection with the foundation investigations which are now so regular a feature of civil engineering work. If the results of such tests cannot be compared, because of varying test methods, confusion will increase. Reference was made to the work of other ASTM committees in

rapidly developing fields where tentative and standard methods of test are adopted and repeatedly revised to keep abreast of new developments.

Chief differences of opinion developed with reference to the design aspects of soil tests. It appeared to be the consensus that ASTM standards should be confined to test methods only but it was suggested that all such standards should be prefaced by a cautionary note explaining the limitations of the tests and their relevance to design.

Discussion was vigorous and pointed and had to be terminated by the chairman due to lack of time at the end of the session. Together with the papers presented it will be most useful to the committee in planning its future work. Material in the papers will be used effectively in writing the introduction to a new edition of the well-known ASTM book, *Procedures for Testing Soils*, which is planned for publication in the latter part of 1956.

R. F. Legget, National Research Council of Canada, Ottawa, was chairman of the symposium and presented the introduction. The following papers were presented:

The History and Development of Committee D-18—E. J. Kilcawley, Rensselaer Polytechnic Institute.

Judgment Factors and the Environment in Soil Testing—D. J. Burmister, Columbia University.

Critical Review of Committee D-18—A. E. Cummings, Raymond Concrete Pile Co. *Future Possibilities and Activities of Committee D-18*—K. B. Woods, Purdue University.

The session concluded with Committee Chairman Kilcawley fulfilling his pleasant duty of presenting the C. A. Hogentogler Award to H. G. Mason, J. A. Bishop, L. A. Palmer, and P. P. Brown. Details of the award are mentioned on page 21 of this BULLETIN.

Concrete

Three papers on widely different subjects contributed to an interesting and useful session on concrete. Carl A. Menzel described a relatively quick method for determining moisture condition of hardened concrete; George Verbeck presented a paper written jointly with Charles Gramlich describing osmotic studies and a hypothesis concerning the alkali aggregate reaction; and J. C. Sprague presented a paper written jointly with C. P. Lindner on the effect of depth of beam upon modulus of rupture of plain concrete.

Annual Meeting Report

In his paper, *A Method for Determining the Moisture Condition of Hardened Concrete in Terms of Relative Humidity*, Carl A. Menzel, Portland Cement Assn., described a rapid method and simple apparatus for determining the moisture condition of hardened concrete block and of expressing the results directly in terms of relative humidity. When hardened concrete is exposed to the air, its moisture content tends to attain a state of balance or equilibrium with the relative humidity of the air. Changes in moisture content may be important in various ways, and it is often desirable to have definite information on the moisture condition of the hardened concrete in block, walls, floors, or other building members.

The procedure described is based on extensive studies to develop the proper apparatus and calibration and testing techniques for making this method as practicable and dependable as possible. This method gives reliable indications of the moisture condition of concrete block in about 15 to 30 min and usually within 20 min. This is less than 1 per cent of the 48 to 72 hr needed to saturate and then oven-dry block to constant weight as required by present specifications for tests of moisture content and absorption.

With slight modifications, the relative humidity method can be used to determine the moisture condition of hardened concrete at the surface and interior of large specimens such as wall and floor slabs. It can also be used to determine the moisture condition of other construction materials and assemblies affected by relative humidity. The method is proposed by Mr. Menzel as an acceptance test that will indicate whether or not a given lot of block meets the degree of dryness required by specifications for a specific purpose. It is also proposed as a plant inspection test that will indicate to the block manufacturer the moisture condition of different lots of block at the plant so that he will know when they are dry enough or what further drying may be required for a specific purpose.

In the paper, *Osmotic Studies and Hypothesis Concerning Alkali-Aggregate Reaction*, by George Verbeck and Charles Gramlich, Mr. Verbeck described an osmotic cell technique for the study of the chemistry and physics of the alkali-aggregate reaction.

The apparatus consists of two chambers separated by a membrane of neat cement paste. Aggregate, solid calcium hydroxide and alkali solution are placed in one chamber, thus simulating

the zone at the surface of aggregate in concrete. This chamber is separated, as in concrete, by cement paste from the second chamber which provides, as in concrete, a reservoir for additional solid calcium hydroxide and the same alkali solution. Capillary tubes attached to each chamber permit the measurement of liquid movement from the reservoir chamber to the reaction chamber as required by the tendency of the reaction products to imbibe water and swell or develop osmotic pressures. This technique, using the apparatus which can for convenience be identified as an osmotic cell, permits the isolation and direct study of several variables including the effects of different alkalis, different alkali concentrations, paste permeability characteristics, aggregate particle size, lime inhibition, and temperature.

Data were presented showing the effect upon osmotic pressure of (1) the permeability of the neat cement paste membrane, (2) alkali concentration, (3) different alkalis, (4) calcium hydroxide, (5) particle size of aggregate, and (6) reaction temperature. Application of these results has led to the development of a hypothesis suggesting possibility that a fundamental and practical remedy to deleterious alkali-aggregate reaction might be obtained by physicochemical adjustment of the mobility functions of alkali and lime by additives (inhibitors) or surface treatment of aggregate.

In the paper *Effect of Depth of Beam Upon Modulus of Rupture of Plain Concrete*, by C. P. Lindner and J. C. Sprague, Mr. Sprague observed that the load at failure of a plain concrete beam does not vary as the conventionally visualized square of the depth, and the modulus of rupture of concrete varies inversely with the depth. The paper attempts to rationalize that behavior and to point out some of its ramifications. The solution of the conventional formula, $S = M_0/I$ does not produce the true tensile breaking stress. An equation termed the "rectibolic formula" is offered for measuring the tensile stress. Its solution yields results that approach more closely the true breaking strength of concrete subjected to bending stresses, though it does not remove the anomaly of reducing apparent breaking stress with increasing depth of beam.

Significance of Tests of Concrete

P. H. Petersen's paper on the *Resistance of Concrete to Fire and Radiation (Including Jet Aircraft Blast)* presented a new problem for cement technicians to consider—that of heat and blast

shock extending into ranges hitherto undreamed of by construction engineers. Testing concrete to discern its suitability for jet aircraft runways and taxiways, or for shelters and structures capable of withstanding the great thermal and pressure shock of nuclear explosions, poses a problem not easily solved. Petersen presented some approaches to this problem and reviewed the current status of research of runway damage due to jet aircraft.

Freezing-and-thawing tests in recent years have come under close scrutiny due to the poor correlation of results from current standard tests and a greater understanding of mechanisms involved during the freezing of the concrete mass. T. C. Powers, in his paper, *Basic Considerations Pertaining to Freezing and Thawing Tests*, discussed his extensive researches in this field which were undertaken at the Portland Cement Assn., Research Section. Powers' study indicated that natural freezing occurs under so many different conditions, amount and distribution of water, and previous history of the concrete that many choices are available to the researcher. Some tests, however, have become routine and introduce conditions fundamentally different from the most prevalent field conditions. Powers reviewed the most important of these discrepancies, particularly those of rate of cooling and length of continuous exposure to moisture. He concluded his paper with a proposed modified test procedure and a discussion of this procedure in the light of his experience.

Research in the concrete field has been in progress for about a century and a half. Despite this sustained interest, much important work remains to be accomplished; this was the thesis

of A. T. Goldbeck's paper, *Needed Research on Concrete and Concrete Aggregates*. Durability of concrete, in terms of freezing-and-thawing tests, was the first subject treated by Goldbeck. This test is under question by virtue of the many known and unknown variables, and the author discussed past research as well as future considerations. Strength properties, plastic flow and stress release, and miscellaneous problems were also discussed considering present knowledge and research activity in progress.

C. E. Kesler and C. P. Siess, in their paper on *Static and Fatigue Strength of Concrete*, discussed the information gleaned from strength tests as a qualitative indication of other important properties of hardened concrete. Since the property of strength is most easily determined, and a test measuring the compressive, tensile, or shear strength or a combination of these, has in most cases a direct influence on the load-carrying capacity of both plain and reinforced concrete structures, these tests are of fundamental importance. Each of various types of strength tests was reviewed giving the significance of the test and test results, preparation of test specimens, and a discussion of the test procedure. The authors made references to over fifty significant research papers which provided a sound background for their discussion.

This third session on the *Significance of Tests of Concrete*, represents the last group of papers to be included in the forthcoming *Special Technical Publication* on this subject, sponsored by Committee C-9 on Concrete and Concrete Aggregates. It is expected the complete volume will be available sometime in the fall.

TECHNICAL COMMITTEES

The technical committees played a most important part in the Annual Meeting. Reports from 65 committees were presented containing many recommendations with respect to standards particularly in anticipation of the appearance of the 1955 Book of ASTM Standards. The actions with respect to committee recommendations on standards are tabulated on page 37. In addition to the sessions devoted exclusively to the presentation of committee reports, many of the other technical sessions comprised symposia sponsored for the most part by the technical committees. In addition, there were over 700 committee meetings held during the Meeting. No attempt is made to abstract the committee reports and refer-

ence should be made to reports as pre-printed. Neither is there any attempt in the statements appearing below to give a complete statement of actions taken at the committee meetings since there will be a more complete discussion of the programs of work before the committees in the September issue of the *ASTM BULLETIN*. Some of the outstanding items concerning activities of the technical committees are set forth below.

A-1 on Steel

At the meeting on June 29, an extended spirited discussion arose on the proposal of one of the subcommittees that the proposed Tentative Specifications for Alloy Steel Castings Normal-

ized and Drawn for High Pressure and Elevated Temperature Service not be recommended to the Society for publication. These specifications were appended to the 1955 Preprint Report of Committee A-1 to the Society. Letter ballot of the committee had resulted in five negative ballots, all with the same objection—that specifications should not contain specified heat treatment in addition to required chemical composition and room temperature mechanical properties. In view of the fact that materials such as are covered by the specifications are required by the present rigorous power station demands, and in fact have been used for years, many of the members believed the specifications should be published in the present form. They have been in the process of development for two or three years. A motion that the specifications be withdrawn from the report did not receive the necessary vote of committee members present. As a result the specifications will be published in the form as attached to the 1955 Preprinted Report of Committee A-1 to the Society.

A-3 on Cast Iron

During the next few months Committee A-3 will letter ballot on the question of American participation in the work of Technical Committee 25 on Cast Iron of the International Organization for Standardization. If approved, the recommendation will be considered by the American Standards Assn. which acts as the American agency for international standardization work.

Several new specifications for nodular iron are in various stages of development, including one for pressure-containing parts ranging from -20 F to elevated temperatures, another for quenched and tempered material, and still another for gas and water line pipe.

A-5 on Corrosion of Iron and Steel

The wire and fence tests of Subcommittee XV on Wire Tests are now approaching 20 years duration of exposure to the atmosphere and the current report appended to the Annual report of Committee A-5 gives data from the 1953 and 1954 inspections at 11 sites. Extent of corrosion is measured by weight losses and by visual examination of all specimens and by tension tests on wire specimens.

Rate of loss of zinc coating tests have now been completed. The annual loss of coating ranges from 0.369 oz per sq ft of surface at Pittsburgh, Pa., to 0.060 oz per sq ft at State College, Pa.

It is of interest to note that chromium steel wires at Lafayette, Ind., corrode differently from those at other sites in that they have a mottled appearance

and tiny spots of red rust scattered over their surfaces.

The hardware tests of Subcommittee XVI on Hardware Tests have been terminated at all locations except Key West, Fla., and State College, Pa. Only the State College site was inspected in 1953 and 1954, the results being appended to this year's A-5 Report.

In addition to extensive revisions in A 93, zinc-coated sheets, and A 361, zinc-coated roofing sheets, Committee A-5 proposed as tentative Specifications for Zinc-Coated Steel Chain-Link Fence Fabric (A 392). As a result of this new tentative, Committee A-5 has withdrawn A 117, Specification for Zinc-Coated Iron or Steel Chain-Link Fence Fabric Galvanized After Weaving, and A 337, Specification for Zinc-Coated Iron or Steel Chain-Link Fence Fabric Galvanized Before Weaving.

The committee recommended as an editorial change in the wire specifications A 111, A 112, A 124, A 218, A 363, and A 326 the following note to the sections on Adherence of Coating: "Loosening or detachment during the Adhesion Test of superficial, small particles of zinc formed by mechanical polishing of the surface of zinc-coated wire shall not be considered cause for rejection."

A-7 on Malleable Iron

At the Annual Meeting, the Committee expressed a desire to amend its proposed revision of the Specifications A 220 for Pearlite Malleable Iron Castings. In addition to grades 45010, 45007, 48004, 5007, 6003, and 8002, the committee intends to add a 53004 grade. Assignment of the above grade designations is accomplished on the basis of the first two numbers indicating the yield point or yield strength in thousand psi, and the last number the elongation in 2 in.

A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys

The committee promulgated as an ASTM Standard a corrosion test method long accepted by industry—the Recommended Practice for Acidified Copper-Sulfate Test for Intergranular Attack in Austenitic Stainless Steels (A 393). In addition, method A 262 (boiling nitric acid test for corrosion-resistant steels) has been revised to include an electrolytic oxalic acid etching test which may be used to estimate whether the specimens examined would show low and relatively constant rates

of corrosion if subjected to the standard boiling nitric acid test.

The first report in six years appears on the part of the Task Group on Inspection of Corrosion-Resistant Steels in Architectural and Structural Applications. Examination was made of 525 William Penn Place, Gateway, and Heppenstall Buildings in Pittsburgh; Allegheny Ludlum Steel Corporation Research Laboratory in Breckenridge, Pa.; Empire State, Universal Pictures and Chrysler Buildings in New York; various installations in Atlantic City; Philadelphia Savings Fund Society and Pennsylvania Buildings in Philadelphia; and the Reading Railroad's "Crusader" stainless steel train. Among the conclusions are:

- 18-8 and 17-7 chromium-nickel grades as well as type 442 are adequate from the standpoint of atmospheric corrosion resistance in urban and industrial locations.
- Type 430 is acceptable where metal surfaces are vertical and subject to the scouring action of wind and rain.
- In locations not subject to the normal cleaning action of the elements type 430 and to a lesser extent types 302 and 442 may require occasional cleaning to avoid light superficial rust.

The A-10 report also contains an appendix covering the work of a Task Group on Nickel-Bearing and Non-nickel-Bearing Stainless Steels. Nine grades of stainless steel each in the No. 2B and No. 4 Finish were exposed on the roof of the Williams and Co. Building in Pittsburgh and the Port of New York Authority Building in New York. In general the specimens at New York show less attack than those in Pittsburgh. The dirt film is also considerably lighter.

An editorial note in Specifications A 276 (hot-rolled and cold-finished steel bars) and any other specifications under the jurisdiction of Committee A-10 having reference to types 304L and 316L cautions against the indiscriminate substitution of the low-carbon grades for type 304 and type 316.

B-2 on Non-Ferrous Metals and Alloys

Committee letter ballot of the Proposed Tentative Specifications for Sponge Titanium resulted in several suggestions which the committee considered very appropriate. As a result, the proposed specifications attached to the Preprinted Report of Committee B-2 to the Society will be amended before publication as tentative specification.

Revisions will include addition of another sampling method and changing the sample weight for determination of hardness from the present "50 g" to "100 g." A minimum button thickness of $\frac{3}{8}$ in. will be specified as well as a 10-mm ball for the hardness test.

The committee is also planning a symposium for the West Coast National Meeting in September, 1956 which will include papers on testing procedures and their results for titanium. The emphasis is planned on non-research papers, although there may be one or two papers on new materials. There will be no physical metallurgy included.

B-3 on Corrosion of Non-Ferrous Metals and Alloys

In addition to sponsoring the Symposium on Corrosion of Non-Ferrous Metals and Alloys, the Committee appended to its annual report a summary of the 20-yr data on 24 non-ferrous metals and alloys exposed to the atmosphere at 7 locations. No attempt is made to analyze the data or to compare the materials. This was left to the authors of the papers in the symposium mentioned above. Data are given for weight losses of 9 by 12-in. plates, tension tests on specimens machined from these plates, and pre-cut tension specimens. All the specimens from this test have now been removed from the racks and the tests can now be regarded as complete.

Preliminary results of the program aimed at calibrating the corrosivity of the atmosphere at various test sites indicate that the weight losses resulting from one year's exposure of panels of zinc and steel will give a good idea of the relative corrosivity of the sites. This program will terminate in 1956.

Rather than transfer the stainless steel couples from their present location in Altoona to another location within the city, it was agreed to terminate these tests, which will result in a total exposure time of 14 yr.

The disk-type magnesium couples composing Part 1 of the magnesium couple program are reported upon in the symposium as is Part 2, the wire and bolt-type group of specimens. Part 1 of the program is continuing; Part 2 has been completed. The third part of the program, the so-called plate-type couples, has reached the point where pilot scale corrosion tests which will indicate the most suitable type of corrosion test specimen have been concluded. Commitments for some of the test materials have already been obtained.

B-6 on Die-Casting Materials and Alloys

Although no recommendation or revisions of standards were promulgated by the committee, it is of interest to note that the Annual Report of the committee contains the 1-yr data of exposure tests initiated in 1952 to determine the effect of zinc on the corrosion resistance of SC84A alloy. The zinc contents being investigated are 0.25, 0.50, 1.0, 1.5, and 2.0 per cent. The test sites and times for exposure are the roof of the Port of New York Authority Building for 1, 3, 6, and 12 yr; Kure Beach, N. C. 80-ft site for 1 and 3 yr; and Kure Beach 800-ft site for 1, 3, and 6 yr.

No final conclusions were drawn from these data. In view of the small sample size and normal expected variation in die-cast tension bars, it would be impossible to state whether the effect of zinc is statistically significant. Normally the per cent elongation tests would assist in determining the significance of an apparent trend in tensile strength. In this case, because of the low values of elongation which are always difficult to determine, coupled with the presence of corrosion products to hinder determination, the accuracy and thus the significance of elongation data cannot be judged.

The committee has also removed aluminum alloy test bars IVa, V, and Va from the New York and Altoona test sites after 20 yr of exposure. Alloy IV was a 5 per cent silicon alloy and Alloy V was a 12 per cent silicon alloy. The "a" designation indicated the use of a high-purity aluminum.

The testing of these bars has been held up because black deposits and white corrosion products have made identification of the specimens a difficult task. This completes the exposure tests on these alloys.

Test specimens of aluminum alloys 218 (GSA) and 360 (SG100A) have been removed from the New York test site after 10 yr of exposure. This completes the exposure test on these two alloys because the specimens at the Sandy Hook site were lost.

A table of die-casting and other characteristics for the aluminum alloys has been prepared for inclusion in the appendix to Specification B 85, Tentative Specification for Aluminum-Base Alloy Die-Castings.

B-7 on Light Metals and Alloys, Cast and Wrought

Although the recommendations of Committee B-7 on various tentatives and standards under its jurisdiction are too numerous to detail here, a number of general comments can be made.

A "Basis of Purchase" section has

been added to the magnesium specifications B 80, B 90, B 91, B 92, B 93, B 107, B 199, and B 217. In addition the tensile requirements for alloys EK30A-T6 and EZ33A-T5 in B 80 have been increased. The Tentative Specifications for Aluminum Bars for Electrical Purposes (B 236) have been revised to add the -H111 and -H112 tempers, edgewise bend requirements, requirements for finish, and revision of dimensional tolerances.

L. H. Adam reported for Subcommittee VIII on Atmospheric Exposure Tests on the data to date from the test specimens of 27 aluminum and 11 magnesium alloys exposed at New York City, State College, Pa., Kure Beach, N. C., Point Reyes, Calif., and Freeport, Tex. Significant changes resulting from the exposure are:

1. With the aluminum alloys the decreases in strength are obscured by the increases due to natural aging of the alloys.

2. Although the magnesium alloys had less than 5 per cent loss in strength due to the 1-yr exposure, the effect of the exposure was definitely apparent in the changes in ductility. Although the surfaces of all specimens were badly corroded, the spot-welded and riveted magnesium alloy specimens cut from the plate were as strong in tension as the originally unexposed specimens.

B-8 on Electrodeposited Metallic Coatings

Although the committee did not meet during the Annual Meeting, a number of revisions and tentatives of standards were submitted for Society approval. Changes in Tentatives A 166 (nickel and chromium on steel), B 200 (lead on steel), and B 201 (chromate finishes on zinc) are based on the definition of significant surfaces and should serve to prevent arguments on this subject which have arisen in the past. Standard A 164 (zinc on steel), A 165 (cadmium on steel), B 141 (nickel and chromium on copper), and B 142 (nickel and chromium on zinc) have been revised to indicate that "wherever possible thicknesses should be measured by magnetic methods on the maximum number of samples practicable since such measurements are non-destructive and inexpensive." The Recommended Practice for Chromium Plating on Steel for Engineering Use, B 177, has had a cautionary note added pointing out that plated parts subject to alternating stresses or designed on the basis of fatigue characteristics should not be baked as baking generally tends to reduce the fatigue strength.

Appended to the B-8 report is the Report of Subcommittee II on Performance Tests. This report is essentially

a continuation of the 1953 report of the Subcommittee. The report is divided into two parts. One part summarizes the results of atmospheric exposure on copper-nickel-chromium deposits on high-carbon steel. The second part of the report gives the results of the atmospheric exposure of the electroplated lead coatings on steel. Of considerable interest is the Appendix to the Subcommittee II report which gives the details on the type of cleaner used; the manner in which the acid copper, nickel strike, and nickel and chromium plates were applied; details of plating tanks; and details of the mask used in locating panel positions for thickness determinations.

Committee B-8 has established a Symposium Committee under the chairmanship of W. L. Pinner. This group has completed its plans for a "Symposium on Properties, Tests, and Performance of Electrodeposited Metallic Coatings" to be given at the Spring Meeting in Buffalo in February, 1956. The symposium will be repeated at the ASTM Pacific Area National Meeting in Los Angeles in September, 1956.

ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals

The extensive amount of work currently carried on by the Joint Committee and its various panels is reflected in the number of publications and papers. Subsequent to the 57th Annual Meeting in Chicago, a number of papers were presented at the 1954 Annual Meeting of the ASME:

Carbon-molybdenum Steel Steam Pipe after 100,000 Hours of Service—R. J. Sinnott, I. A. Rohrig, J. W. Freeman, and A. I. Rush

Investigation Into Blade-Root Fixings of High-temperature Steels—W. Siegfried
Factors Influencing the Notch Fatigue Strength of N-155 Alloy at Elevated Temperatures—W. S. Hyler and W. F. Simmons

Factors Influencing the Notch-Rupture Strength of Heat-resistant Alloys at Elevated Temperatures—R. L. Carlson, R. J. MacDonald, and W. F. Simmons

Properties of Cast Iron at Elevated Temperatures—J. R. Kattus

At the Spring Meeting of ASTM, eight papers were presented in a Symposium on Effect of Cyclic Heating and Stressing on Metals at Elevated Temperatures. This symposium is being published as *ASTM STP No. 165*. Projects DP-3 and DP-4 of the Data and Publications Panel have been completed with the publication of the Report on Elevated Temperature Properties of Chromium-Molybdenum Steels (*ASTM STP No. 161*) and Report on the Elevated Temperature Properties of

Selected Superstrength Alloys (*ASTM STP No. 160*). The report on the low-carbon steels is in the hands of ASTM for publication and it is expected that the report on the elevated-temperature properties of copper alloys will be completed within a few months as will also the relaxation data report.

Various other studies are underway including Aviation Panel Project AP-3 dealing with a collection of data on the effect of temperature on the mechanical properties of titanium and titanium alloys and Gas Turbine Panel Project GTP-2 concerning a study of the oil ash corrosion problem. A progress report on Project SP-2 (elevated temperature properties of cast iron) was presented at the 1954 Annual Meeting of ASME and this work is continuing. Project SP-5 of the Steam Power Panel has organized a joint Edison Electric Institute-Joint Committee Task Force to gather and correlate relevant work being carried on in various agencies on the use of austenitic steels for steam line service.

Three well-attended sessions were held at the Annual Meeting this year. The two-session Symposium on Metallic Materials for Service above 1600 F was sponsored by the General Research Panel and the Panel Session on Pyrometric Practice of Elevated Temperature Testing was sponsored by the Test Methods Panel.

C-1 on Cement

An outstanding attendance of 85 out of a total of 89 members of the committee was recorded at the main meeting on June 30. Preliminary to the many subcommittee reports a paper was presented on the subject of false set by W. C. Hansen, Universal Atlas Cement Co., and Chairman of the Working Committee on False Set. At each meeting of the committee, it is customary to have a prepared talk from one of the working committees in order to acquaint the entire membership more fully with the various projects.

An important change was accepted, following unanimous permission by the committee for its consideration, to the Annual Report pertaining to the two widely used specifications for portland cement, C 150 and C 175. The action taken changed the existing recommendation from that of a revision and reversion to tentative status of these two standards to a revision for immediate adoption, thereby preserving their status as full standards. This involved no change in substance of the original

revisions contemplated. A further change in the SO₃ content for portland cement for Type IV was approved, thus changing the requirement to 2.3 per cent. Another important specification received attention, namely, the Specification for Masonry Cement (C 91). In order to incorporate certain revisions embodying use of the same testing procedure for strength and air entrainment currently used in the Federal specification for masonry cement, the committee accepted proposed revisions including reversion to tentative status of the standard in order that the changes may be included directly in the text.

An extensive cooperative program conducted at the University of Maryland with the National Ready Mixed Concrete Assn., relating to the strength variation of portland cement, was reviewed indicating further work is required now that the tensile strength remains as an alternate requirement. A performance test for measuring potential sulfate resistance of portland cement has been prepared and was accepted for publication as information. Good agreement has been reached on extraction tests, sponsored by the Working Committee on SO₃ Content.

An interesting part of the meeting was the presentation of certificates to the honorary members of the committee. The honorary members present included Louis Anderson, P. H. Bates, and Joseph Brobston. In addition, John R. Dwyer, Technical Assistant of the committee, was made an honorary member and received a certificate.

C-3 on Chemical-Resistant Mortars

Progress was the theme of subcommittees reporting at the meeting of the committee on June 29. Plans were laid for the reorganization of all subcommittees to provide for work on mortar properties not now covered by the present committee activities. A more complete report of the work program of the committee will be published in the September BULLETIN.

C-7 on Lime

The research program on soundness characteristics of limes under the direction of W. C. Voss was reviewed extensively at the meeting of the committee on July 1. Results of autoclave tests and records of expansion and movement of brick piers in a controlled mois-

ture room were cited on neat, high-calcium, type S and type N limes. It is expected that the results of this program will influence the present soundness requirements for lime. Organizations now participating include Massachusetts Institute of Technology, Battelle Memorial Inst., Marblehead Lime Co., and the National Gypsum Co.

Two proposed methods on neutralization of acid wastes were approved for circulation to the committee, with more round-robin testing being planned. The combination of the two existing standard specifications for finishing lime, C 6 and C 206, was approved for committee letter ballot with no changes in substance being contemplated.

A movie in color was presented by Professor Voss, showing the effect of expansion on mortar, the study of forces involved, and the effect on masonry structures.

C-9 on Concrete and Concrete Aggregates

Twenty-four of twenty-nine subcommittees of the committee held meetings climaxed by a very well-attended meeting of the main committee. The majority of the subcommittee reports were in the nature of progress and a more complete article on the work program of the committee will be published in the September BULLETIN.

Revisions of the Standard Method of Test for Compressive Strength of Molded Concrete Cylinders (C 39) were approved for letter ballot of the committee, giving specific limitations on the relation of the diameter of specimen to diameter of bearing block in the compression test apparatus. Further revisions were discussed for the specifications on lightweight aggregate, in which the need for certain test methods was indicated. The proposed specification for natural pozzolanic materials was brought closer to final draft form as a result of the meeting. A revision in the Specification for Ready-Mixed Concrete (C 94) further clarifies the description of the scales for weighing cement.

The committee approved the contents of the greatly expanded special publication on significance of tests and properties of concrete and concrete aggregates. It is now expected to have this important publication available some time this fall.

C-11 on Gypsum

A variety of projects occupied the attention of Committee C-11 ranging from refinements in the physical test

procedures in the Standard Methods of Testing Gypsum and Gypsum Products (C 26) to a proposed specification for gypsum wallboard nails.

A revised form of the normal consistency of gypsum plaster was reviewed and discussed. The proposed specification for nails will cover annular ringed steel wire nails designed for use in application of $\frac{3}{8}$ and $\frac{1}{2}$ in. gypsum wallboard. Another proposed specification considered was for precast reinforced gypsum slabs consisting essentially of gypsum, metal reinforcing, and wood fibers, chips, or shavings.

C-12 on Mortars for Unit Masonry

Contemplated changes in the Standard Specification for Mortar for Unit Masonry (C 270) pertaining to lime types was withheld by the committee pending completion of research on expansion by Committee C-7 on Lime. This was announced at the meeting of Committee C-12 on June 30. The effect of the addition of sand on the expansion of mortar will also be included in the research data to be made available.

The consideration of an escape clause for off-grade sands used in mortar is still in progress. These sands will be studied in terms of water demand, being compared with a standard grading to be used, in round-robin tests.

It was reported that the proposed method of test for efflorescence has developed some difficulties in the penetration of water through the wick, thus needing refinement. A research project is under way at the University of California at Los Angeles.

The committee agreed that joint jurisdiction with Committee C-9 on Concrete and Concrete Aggregates was not necessary on packaged, dry-mixed mortar as long as the Specification for Mortar for Unit Masonry (C 270) was used as a reference for masonry mortars with suitable marking of type of mortar being made on the package.

C-15 on Manufactured Masonry Units

The very difficult problems confronting the new Subcommittee on Waterproofing Materials were reviewed briefly by Subcommittee Chairman C. C. Connor, Bell Telephone Co. of New Jersey, at the meeting of Committee C-15 on July 1. In attempting to establish a scope of operation, it was noted that two distinct views must be resolved: (1) reduction of capillarity, and (2) reduction of dependability of the masonry. The many types of materials being used creates difficulty in classification. With no uniform terminology available, the term "moisture-

resistant coatings" will be used. Further delineation of the scope resulted in the decision to work initially on coatings used above grade and of the transparent type.

A second important development in the committee in the special products field is the preparation of a proposed specification for ceramic tower packing. A draft will be circulated to additional manufacturers for comment. The writing of a proposed method of test for determining the moisture condition of concrete block in terms of equilibrium relative humidity was agreed upon and will be handled in Subcommittee III.

D-1 on Paint, Varnish, Lacquer, and Related Products

The Committee and 76 of its subcommittees and working groups held meetings over a three-day period. A highlight of the meeting was an illustrated paper on The Importance of Test Methods for Controlling the Quality of Paints Used by the U. S. Navy, by W. W. Cranmer, Philadelphia Naval Shipyard. There was an attendance of about 250 members of the committee, which gave evidence of the wide interest in this subject.

The new Tentative Recommended Practice for Reporting Particle Size Characteristics of Pigments (D 1366), was considered a timely contribution. It answers a long-felt need for reporting fineness characteristics of pigments in the subsieve range. By use of this method of reporting, it is possible to make comparison when pigments are tested by any one of several methods now in use such as the microscopic, sedimentation, and turbidimetric methods; and partially to absorption and permeability methods.

There were two new tentative methods for fire retardancy of Paints, namely, the Cabinet Method (D 1360) and the Stick and Wick Method (D 1361). Both of these methods fill a real need in view of the recent development and use of nonflammable type paints. Continuing its plan to establish separate methods for the various procedures now covered in the general Methods of Sampling and Testing Lacquer Solvents and Diluents (D 268), three new tentative methods, were presented, covering, respectively, Alcohol in Methyl Isobutyl Ketone (D 1362), Permanganate Time of Lacquer Solvents and Diluents (D 1363), and Test for Water in Lacquer Solvents and Diluents (Fischer Reagent Titration Method) (D 1364).

An important addition to the Test Methods for Traffic Paint was a new laboratory test for determining the

length of drying time after application for no-smear of traffic or pavement-marking paint by the tire of an automobile. A new method for spectrophotometric Diene Value of Dehydrated Castor Oil and Its Derivatives was presented as tentative. For use in determining small daylight color differences between surface colors, there was presented a new Tentative Method of Test for Color Difference Using the Hunter Color Difference Meter (D 1365).

Appended to the report as information only were two proposed methods—Test for Nonvolatile Content of Heat-Unstable Resin Solutions by Foil Method, and Methods for Analysis of Polyvinyl Butyral.

D-2 on Petroleum Products and Lubricants

Committee D-2 again had the distinction of submitting to the Society the largest report totaling 101 pages. Another indication of the extent of the activities of this committee was the 95 meetings of D-2 divisions and subcommittees held over the entire six days of the Annual Meeting.

The committee deleted from its report one recommendation—the proposal to withdraw the Tentative Method of Test for Steam Emulsion of Lubricating Oils (D 157 - 51 T). When a replacement method is available withdrawal of method D 57 will again be considered.

In the revised Method of Test for Olefinic Plus Aromatic Hydrocarbons in Petroleum Distillates (D 1019), the committee withdrew from the method Appendix IV on Centrifuge.

Of particular significance was the completion of extensions to Tables 6 and 7 and a new abridged table for liquefied petroleum gases to be added to the ASTM-IP Petroleum Measurement Tables (ASTM D 1250; IP 200). The extensions of Tables 6 and 7 provide values for a temperature range from 0 to -50 F for volume corrections with entry in API gravity. These additional tables are now being reviewed and checked by the Institute of Petroleum (London).

Twelve proposed methods of test were submitted for publication as information only for trial use during the coming year. These covered such subjects as emulsion stability of cutting oils, galvanic corrosion of instrument oils, blocking point and oxidation stability of waxes, estimation of heat of combustion of petroleum, tetraethyl lead in gasoline by polarograph, consistency and deleterious substances in greases, tests for benzene and individual xylenes by infrared spectrophotometry, and water in bituminous materials.

The new proposed test for measuring color of petroleum products provides a

set of glass color standards that are expressed in fundamental terms and are of proper chromaticity. This new ASTM Color Scale differs slightly from the Union Scale in that the difference in chromaticity (spacing) between the successive glasses is uniform throughout the scale.

Motor Fuel Rating Methods:

The Motor and Research Methods for determining the knock characteristics of motor fuels, with a number of editorial changes in the six supplements which contain detailed information regarding the apparatus, reference materials, operation and maintenance of the engines and their installation and assembly, was published in a separate "Manual for Rating Motor Fuels by Motor and Research Methods," available early in the fall. Following its publication the Aviation and Supercharge methods, together with their supplements, will be revised and brought up-to-date and published in a companion manual. Likewise the Cetane method for rating diesel fuels will be published in a separate manual together with supplementary information. It is expected that these two latter manuals will be available late in 1956 or early 1957.

West Coast Meeting Plans:

In view of the committee's intention to participate in the West Coast National Meeting of the Society to be held in Los Angeles in 1956, plans are under consideration for three symposia to be sponsored by the committee. The Technical Committee on Gasoline is planning a Symposium on Vapor Phase Oxidation of Gasoline. A new look at the present Grades and Uses of Lubricating Oils will be covered by another symposium sponsored by Technical Committee B on Lubricating Oils and Research Division III on Elemental Analysis. The third symposium will be devoted to turbine oils under the sponsorship of Technical Committee C.

At the Annual Dinner of Committee D-2, the guest of honor was Oscar Lewis Maag, who served as chairman of the committee for three terms from 1949 to 1955. In addition to directing the activities of the committee, Mr. Maag was also active in a number of research divisions and subcommittees, and was chairman of Technical Committee K on Cutting Fluids from 1946 to 1952, also taking an active part in Technical Committee G on Lubricating Grease. Mr. Maag has retired from his company and has resigned as chairman of the committee. H. M. Smith has been

appointed to serve the balance of Mr. Maag's unexpired term.

D-4 on Road and Paving Materials

Simplification in the types of emulsified asphalt covered in the Standard Specification for Emulsified Asphalt (D 977) will be accomplished by action instituted at the meeting of the committee on July 1. Consideration was given to the elimination of the low-consistency (MS-1) and the high-consistency heavy-premix grade (MS-3)—both in the medium-setting category. In addition, the specific gravity of residue requirements will also be eliminated.

A revision in the Method of Test for Penetration of Bituminous Materials (D 5) was considered, which will provide for the addition of tolerances on the loads and temperatures used. Discussion was reopened on the proposed stripping test, originally published as an appendix to the 1953 Annual Report. It is the intention now to prepare a new draft of this proposed method for possible acceptance by the Society. The determination of the rate of setting up of liquid asphalts (rate of cure), by use of a rolling ball method, was given consideration. An alternate method was considered by the Subcommittee on Expansion Joint Materials in order to provide a shortened method for evaluating these materials.

A symposium on the effective specific gravity of aggregates in bituminous mixtures was approved for presentation in 1956, either at the Pacific Coast meeting in Los Angeles or at the Annual Meeting. These papers have been tentatively arranged for under the chairmanship of H. T. Williams.

D-5 on Coal and Coke

During the week of June 6 to 10, Committee D-5 was represented at the International Standards Organization, Technical Committee 27, in Stockholm, Sweden, by W. A. Selvig and O. W. Rees. Financial assistance to the committee which made attendance of two delegates to these meetings possible was due to the interest of nine coal companies and two coal associations. Reporting at Atlantic City, the delegates reviewed the actions of the ISO/TC 27 meetings and pointed out the tremendous amount of research information available to participating members between meetings, which not only aids deliberations at the meeting but is most helpful for committee interests during the year.

A cooperative investigation is being

made of the Arnu dilatometer in response to a request that a laboratory coking or caking test be available for possible use in conjunction with the present Standard Specification for Classification of Coals by Rank (D 388) in a manner similar to that proposed by the Classification Working Party of the Economic Commission for Europe, Coal Committee. Good reproducibility is secured in the Arnu test by one laboratory between duplicates as well as between two different operators. Inter-laboratory agreement was poor, due possibly to equipment differences. Although significant correlations were found between volatile matter content, Arnu maximum dilation, and Gieseler maximum fluidity, the consensus was that further work on the Arnu test should be held in abeyance in favor of extra effort toward standardization of the Gieseler test.

A second-draft proposal for the Gieseler method has been distributed for comments and criticism. A third-draft proposal on Moisture Holding Capacity of Coal at 97 per cent Relative Humidity and 30 C is under review. Work is continuing on comparisons of volatile matter determination by ASTM standard and modified procedures, as well as by the British single-crucible and the French double-crucible methods.

The committee initiated an inter-laboratory series of sampling tests based upon the work presented in the Symposium on Coal Sampling, now published as *Special Technical Publication No. 162*. This program is intended to be used as a basis of discussion of a proposed standard sampling method to be used by the Committee D-5 delegation for presentation to ISO/TC 27 on Solid Mineral Fuels, next year.

D-8 on Bituminous Waterproofing and Roofing Materials

Highlight of the meeting of the committee was the 50th Anniversary Luncheon held Wednesday noon, June 29. The committee was well represented, with many longtime members present. In the absence, through illness, of R. R. Thurston, Chairman on Arrangements, W. F. Fair was master of ceremonies. Brief talks were given by the present chairman, H. R. Snook; R. J. Painter, Executive Secretary; and N. L. Mochel, President of the Society. The speakers in turn reviewed the history of the committee, stressed the great contribution made by the committee, and the pronounced effect on the development of the industry, and complimented the membership on its devotion to the work of the committee.

D-9 on Electrical Insulating Materials

The committee authorized the appointment of a representative to the Coordinating Committee on Cellular Materials because of interest in the dielectric properties of plastic foams used in radomes and similar electrical applications. It was pointed out that electrical measurements at radar frequencies is a suitable subject for consideration by the committee.

Plans for symposia went forward with one on Corona to be held in the fall and a Symposium on Minimum Values (Minimum Quality Levels) to be held during the spring meeting.

The committee approved a recommendation of its advisory group to work on standard for magnet wire. It was requested as part of the recommendation that the interest of industry and other technical committees of the Society be surveyed with a view to securing adequate representation in Committee D-9 to develop magnet wire standards. Magnet wire insulations are based on a variety of coating materials including modified vinyls, polyesters, and polyurethanes as well as the phenolics.

The committee is currently engaged in another project involving an insulated conductor—copper clad laminates used in printed circuits. The project is in early draft stages in subcommittee and it will be some time before a standard will be available in print.

D-11 on Rubber and Rubber-Like Materials

The committee and 23 of its subcommittees held meetings over a three-day period. The new Subcommittee XIII on Synthetic Elastomers, organized in Cleveland on May 3, held its second meeting. Progress reports were received from the following six sections which were appointed at the organization meeting: Sampling, Chemical Tests, Physical Tests, Latex, Test Methods, Nomenclature, and Reference Materials.

The subcommittee is reviewing six methods from the Specifications for Government Synthetic Rubbers, subcommittee by the synthetic rubber producers. Four of these are under study by the Section on Chemical Tests, namely, methods for determination of: (1) moisture by the hot mill method, (2) ash, (3) carbon black in masterbatch, and (4) bound styrene in butadiene-styrene rubbers. The other two methods on Mooney viscosity and properties of vulcanizates are being considered by the Section on Physical Tests. Methods of sampling, tests for latex, definitions and nomenclature, and arrangements for making reference ma-

terials available are being studied by the other four sections.

Committee D-11 withdrew from its report recommendations for adoption as standard of the following tentatives:

Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (D 735-54 T)

Methods of Test for Hardness of Rubber (D 314-52 T)

Methods of Test for Calibrating a Light Source Used for Accelerating the Deterioration of Rubber (D 749-43 T)

Methods of Test for Plasticity and Recovery of Rubber and Rubber-Like Materials by the Parallel Plate Plastometer (D 926-47 T)

Methods of Test for Accelerated Ozone Cracking of Vulcanized Rubber (D 1149-51 T)

Methods of Test for Resistance to Aging of Vulcanized Rubber by Measurement of Creep (D 1206-52 T)

The committee submitted an additional recommendation for adoption as standard of the Tentative Methods of Testing Automotive Hydraulic Brake Hose (D 571-52 T) without revision. This recommendation was accepted unanimously by the Annual Meeting subject to favorable letter ballot of Committee D-11.

The committee also recommended that a note be included in the Tentative Method of Test for Resistance to Accelerated Light Aging of Rubber Compounds (D 750), subject to favorable letter ballot of the committee.

One of the important proposals submitted by Committee D-11 was the new Tentative Specifications for Ozone-Resistant Rubber Insulating Tape (D 1373) covering a type of tape now in wide use and commercially available. They represent the result of several years' study by the Subcommittee on Tape and are expected to fill a real need in the electrical industry.

An important change was made this year in the 90-deg Stripping Test for Adhesion of Vulcanized Rubber to Metal (D 429). The method covers the adhesion testing of rubber parts assembled to one metal plate. It has been evaluated by extensive cooperative testing and statistical analysis of the results and has been shown to be superior to the present method.

The committee took action on a number of recommendations which it plans to submit to the Society through the Administrative Committee on Standards. One of these covered a new Tentative Method for Inter-Laboratory Testing of Rubber and Rubber-Like Materials. Agreement was reached on a new Method for Determining Hardness of Elastomers at

Low Temperatures based on the method submitted by the ISO Technical Committee 45 on Rubber. A new Method of Test for Stress Relaxation of Vulcanized Rubber in Compression was also completed. This method has resulted from the studies reported in the two papers published in the ASTM BULLETIN for July, 1954, pp. 67 and 73 (TP 146 and TP 151). The method is intended particularly for the testing of rubber used as gasket materials. Extensive changes will also be recommended in the Tentative Recommended Practice for Conditioning of Rubber and Plastic Materials for Low-Temperature Testing (D 832).

D-13 on Textile Materials

Committee D-13's annual report contained 30 recommendations affecting standards of which nine were new tentative methods.

Although there was no meeting of Committee D-13, the Officers Committee and the D-13 Advisory Committee met on June 29. There were about 65 members of Committee D-13 attending the Annual Meeting primarily to hear the Marburg Lecture presented by one of its members, W. J. Hamburger (see report on page 5).

At the meeting of the Advisory Committee, action was taken, subject to approval by Committee D-13, to streamline the work of the committee through establishment of separate subcommittees on methods of testing fibers, yarns, and fabrics, and also a subcommittee on chemical and performance test methods. The work on cotton fibers and wool fibers will continue to be handled by separate subcommittees. It is planned to have the organization meetings of these subcommittees during the D-13 Meetings to be held on October 18 to 21 in New York City.

The Method for Analysis of Asbestos-Glass Fiber Textile Materials, which appeared in the preprint as tentative, will be published as information only.

The committee presented the first Methods for Testing Warp Knit Fabrics. These covered procedures for determining the yield, weight, wale and course count, and invoiced width of warp knit fabrics.

Of particular interest were the comprehensive Methods of Test for Pilling Propensity of Textile Fabrics. These methods covered four different procedures and apparatus for determining pilling characteristics. Evaluation of pilling is very complex as it is affected by many factors such as type of fiber or blend, yarn and fabric construction, and fabric finishing treatments. The new Methods of Testing Wide Elastic Fabrics cover the testing of materials

containing natural or synthetic rubber yarns in combination with textile yarns. A further contribution on the subject of abrasion was a complete new method for evaluating the abrasion resistance of textile yarns. This method supplements the present Tentative Methods of Test for Abrasion Resistance of Textile Fabrics (D 1175). Extensive changes were made in Procedures B and D of Methods D 1175.

New Tentative Methods for Maturity of Cotton Fibers (Polarized-Light Method) (D 1450), and Fineness of Cotton Fibers by Resistance to Air Flow (Arealometer) (D 1449 - 55 T), and the new Standard Method for Length and Length Distribution of Cotton Fibers by the Array Method (D 1440) will eliminate the need for the General Methods of Testing Cotton Fibers (D 414). The latter were accordingly withdrawn.

Several very important methods were presented for determining the fineness of wool: Tentative Specifications and Method of Test for Fineness of Wool Tops (D 472), and for Fineness of Wool (D 419), new Specifications and Method of Test for Fineness of Mohair Tops (D-1379), and also revised Tentative Method of Test for Fiber Length of Wool Tops (D 519).

Included also as information only

were two proposed methods which cover respectively Test for Linear Density of Textile Fibers by the Vibroscope, and Test for Cotton Content of Asbestos Textile Materials (Referee Method).

One very important accomplishment was the new Tentative Methods of Testing Spun and Filament Yarns Made Wholly or in Part of Man-Made Organic Base Fibers. These new methods represent a consolidation and extensive revision of the former yarn Methods D 258, D 507, and D 508.

D-17 on Naval Stores

Numerous tests on the crystallization of samples of gum rosin have been conducted using samples from different points within the producing areas and at different times during the season. From the data derived from these tests, a proposed method of testing the crystallizing tendency of gum rosin was published for information. This initial study was limited to gum rosin as the crystallization tendency of wood and tall oil rosins tested was too great to permit sharp differentiations by this test.

Collaborative work on the Standard Methods of Testing Tall Oil (D 803 - 51), has indicated a number of changes



Every nook and cranny of public space at Chalfonte-Haddon Hall and several other Atlantic City hotels were used for technical sessions and committee meetings. Typical of several hundred small groups, shown here on the porch of Haddon Hall, is a Task Group Division for Test Recipes for Evaluating Carbon Black—a special subcommittee of D-1 on Paint, Varnish, Lacquer, and Related Products.

which will shortly be submitted to the committee.

A proposed method was presented which tests and evaluates tall oil skimmings, the crude product of the paper pulp process from which whole tall oil is recovered by acidulation.

D-18 on Soils for Engineering Purposes

The very important phase of sampling of soils will now be covered by three new tentative sampling procedures as a result of action taken at the meeting of the Committee on June 29. After extensive investigation the committee approved for letter ballot procedures for auger boring, split spoon, and the Shelby tube devices. A revision of the Tentative Method of Grain-Size Analysis of Soils (D 422) is now planned, which will pay particular attention to the maximum size of particle involved. Revisions were approved for committee letter ballot to the Tentative Method of Test for Moisture-Density Relations of Soils (D 698), which will incorporate the use of four sizes of materials.

An organization meeting of the new Section on Soil Conditioners was held, with the first objective being that of developing a scope of operation in this field. A draft of a proposed method on bearing ratio of soils has been prepared for distribution with other bearing tests being considered. A proposed method of test for determining chlorides in soils was approved for letter ballot of the committee.

Special subcommittees were authorized to be responsible for a complete review of the widely used "Procedures for Testing Soils" and for the preparation of papers to be presented at the Pacific Coast meeting of the Society in 1956.

D-19 on Industrial Water

The Annual Meeting activities of the committee were highlighted by the presentation of the second Max Hecht Award to Everett P. Partridge and by the Symposium on High Purity Water Corrosion, sponsored by the committee.

The recommendations presented to the Society for action included a new Tentative Method of Test for Hydrazine in Industrial Water and revisions of fifteen existing standards and tentatives. Arrangements were approved for a full day of papers sessions covering industrial water and industrial waste water as a part of the national meeting of the Society to be held in Los Angeles in September, 1956.

D-20 on Plastics

Of special interest was the action of

the committee to establish a new subcommittee (XX) on Cellular Plastics. For the present, the subcommittee will serve as a center of activity in Committee D-20 on these materials and to provide representation to the Coordinating Committee on Cellular Materials. Presumably, the subcommittee might begin at once to develop standards for rigid foamed plastics not being handled by other ASTM committees. The rubber-like foamed plastics are being handled at present under Committee D-11 on Rubber and Rubber-Like Materials.

A new project on casting resins has been set up under Subcommittee XVI on Thermosetting Materials.

Several revisions of tentatives and new tentatives approved for ballot included an addition of 16 terms to the list of definitions (D 883), and proposed new specifications for nonrigid polyvinyl chloride, and monochlorotrifluoroethylene.

Possible participation by the committee in the Fall 1956 West Coast Meeting was considered. Because of the interest on the coast in reinforced plastics, Subcommittee XVIII on this subject expressed a favorable reaction to participating as a subcommittee, though it is unlikely that the entire Committee D-20 will choose to meet in Los Angeles in September, 1956.

E-1 on Methods of Testing

A conference to consider the initiation on work on laboratory balances was held on June 29. Various types of balances are now specified in ASTM methods for the accurate weighing of samples, and it is believed that a task group under Committee E-1 could serve a very useful purpose in advising the technical committees on details concerning requirements for balances for such applications. At the meeting it was decided to proceed with the preparation of performance specifications for analytical balances. A formal organization meeting of the task group will be held during ASTM Committee Week in March, 1956. The chairman of the Task Group is L. B. Macurdy, Chief, Mass Unit, Mass and Scales Section, National Bureau of Standards.

The subject of Thermocouples and Similar EMF Instruments, was considered at another conference on June 30. This meeting was well attended, and included not only representatives of the Technical Committees now using thermocouples in test methods but also representatives of the manufacturers of thermocouple wires and emf instruments. The committee representatives

referred to various methods which now specify the use of thermocouples for temperature measurement. They pointed out that there is a need, on the part of Society Committees, for more detailed information that can be used in specifying more completely the types of thermocouples to use for accurate measurement of temperature. Specific reference was made to the three high-temperature test methods developed by the Joint Committee on Effect of Temperature on the Properties of Metals. There is urgent need for adequate specifications for types of thermocouples for use in these test procedures. It was also pointed out that much higher temperatures are being used today in industry, and this further emphasizes the need for information on pyrometric practice, and the proper use and applications of thermocouples. A special committee is being appointed immediately to proceed with a review of this subject.

Committee E-1 is considering two symposia for the 1956 Annual Meeting of the Society. For the Symposium on Tension Testing of Non-Metallic Materials plans were made for the subjects to be covered and arrangements for authors of the respective papers. This Symposium will be a companion session to the Symposium on Speed of Testing of Non-Metallic Materials held at this Annual Meeting.

The other symposium planned for 1956 will cover the newer methods and techniques that are now in use for determining the fineness of materials in the sieve range. It is also planned to include papers discussing specific applications of these methods to various materials in industry. Plans are also under consideration in Committee E-1, for a third symposium, which will be devoted to Viscosity Measurements, to be sponsored jointly with the Society of Rheology.

Committee E-1 withdrew from its report the recommendation for adoption as standard of the Tentative Methods of Compression Testing of Metallic Materials (E 9 - 52 T). Review of the methods at the meeting indicated the need for some minor changes before they are adopted as standard.

A new Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers (E 110) was accepted as tentative. This Method is applicable only to those portable hardness testers, which apply the same nominal loads, and use the same indenters as are used in ASTM Methods, E 10, E 18, and E 92.

A Method for Determination of Young's Modulus at Room Temperatures (E 111 - 55 T) was also accepted as tentative.

The present standard Methods of Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials (E 18) was revised and reverted to tentative. The revision, while largely editorial in nature, involves a considerable rearrangement of the text. In the revised method the sections dealing with equipment requirements and general information for the user are separated from those covering the test procedure, and calibration of the apparatus. The Tentative Methods of Verification of Testing Machines (E 4), and the Methods of Verification of Calibration Devices for Verifying Testing Machines (E 74) were revised to include the use of the "equal-arm balance and standard weight," for verifying testing machines. The Specification for ASTM Thermometers (E 1) were revised, and it was announced that other changes in the specifications would be made during the summer, involving the addition of six thermometers for engine testing of fuels, and specifications for the Tung oil thermometer. Also the Specification for ASTM Hydrometer (E 100) will be revised to include 27 new general purpose specific gravity hydrometers, and a change in the over-all length of the API thermo-hydrometers.

E-5 on Fire Tests of Materials and Construction

The widely used Standard Methods of Fire Tests of Building Construction and Materials (E 119) will receive further revisions as a result of the meetings of the Committee on June 27 and 28. Changes were recommended, placing a restriction upon the use of the alternate test for solid structural steel beams and girders where the protection is not required by design to function structurally, and the advisability of inserting some criteria for determining load failure with respect to the requirement that construction should sustain the applied load during the fire endurance test. The revision of E 119, as presented to the Society in the Annual Report, was also approved for recommendation as an American Standard.

A full report was presented on the research work being conducted at the Forest Products Laboratory on the modified tunnel test apparatus in measuring flame spread. Much closer agreement has now been reached between the results of tests on similar materials with those of the large-scale tunnel test at the Underwriters Laboratories (E 84). Further work was recommended which will require additional funds. A report was also

presented on work at the National Bureau of Standards in connection with the radiant panel test.

It was emphasized at the meeting that the building code officials throughout the country are relying on ASTM and in particular the efforts of Committee E-5 in the development of standard fire resistance and flame spread tests which can be referred to in building codes.

E-6 on Methods of Testing Building Constructions

The place of Committee E-6 on Methods of Testing Building Constructions in the family of ASTM technical committees, as well as the future developments which might be expected in its activities, were thoroughly discussed at a general meeting held on June 29 followed by a technical session. A very representative group attended the meetings, presenting a good cross-section of many interests in the building construction field, including the building code authorities.

Chairman R. F. Legget reviewed the history of the committee, with past Chairman L. A. Liska describing the recent developments in the committee, particularly citing the example of cooperation with Committee C-16 on Thermal Insulating Materials in the development of a racking load test. It was agreed that there is much to be done in the field of testing building constructions and that ASTM is the logical place. Standard test methods are needed by building code authorities, such as to cover assemblies and the testing of insulations. There was no differentiation evaluation-wise between prefabricated and the *in situ* types of building structures. Better types of roof structures are needed, which will require standard tests. Recent developments on the West Coast in the use of reinforced brick masonry construction opens a field of testing which could be coordinated with existing ASTM committees interested in the particular materials involved. A standard method is needed for the testing of window assemblies.

The testing of joints and connections, which has had very little progress in the committee, is one of the most difficult fields in which to set up evaluation procedures. Three major obstacles are: (1) the diffuseness of the problem, there being many types of jointing with the question of coupon versus full-size joint tests being in-

volved; (2) the lack of clear-cut recognition of the need; and (3) the lack of proper representation on the committee.

Other comments cited the problem of multiple testing in comparison of assemblies of different materials, the fact that evaluation of the needs should be done early in any development, and that in every case the end-point results on the entire structure need to be stressed. It was felt that there would be coordination necessary with a good many of the existing ASTM technical committees, particularly Committee C-19 on Structural Sandwich Constructions and Committee E-5 on Fire Tests of Materials and Construction.

In the afternoon session, a paper on A Philosophy of Load Tests for Structures, by W. R. Schriever and D. B. Dorey, National Research Council of Canada, was presented. Described by the chairman of the session, R. F. Legget, as a fruitful piece of international cooperation, the paper was made possible through the cooperation of the National Bureau of Standards in Washington, D. C., and the Division of Building Research of the National Research Council of Canada and is a result of the joint efforts of personnel of both organizations. Through a comparison of the load test specifications of many building codes throughout the English-speaking world, the authors drew attention to shortcomings of existing loading test specifications and attempted to combine certain principles into a philosophy on loading tests which will be in closer harmony with the present state of scientific knowledge.

The fact that such load test requirements may go beyond the actual strength requirements and deflection limitations was suggested by a remark from the floor that in one laboratory it had found the human foot could detect floor movements of as little as 2 or 3 thousandths of an inch, suggesting that psychological factors also might be a consideration in addition to the usual considerations of strength and deflection.

E-12 on Appearance

The committee recommended the adoption as standard of the Tentative Method of Test for 45 deg, 0 deg, Directional Reflectance of Opaque Specimens by Filter Photometry (E 97) with a revision which makes the method applicable to the testing of ceramic whitewares.

It also submitted the following new note to appear under Section 2:

Norx 3.—Blue light reflectance by this method differs slightly, both spectrally and geometrically, from the TAPPI methods for paper and pulp brightness.

The committee decided to prepare an ASTM Manual on Appearance Evaluation designed primarily to orient the materials engineer unfamiliar with appearance measurement and specification. It should answer three general questions:

- What are the nature and dimensions of appearance?
- How may these dimensions be measured and specified?
- How are appearance attributes of various types of materials now measured and specified?

F-1 on Materials for Electron Tubes and Semiconductor Devices

After a joint meeting with its parent group, Committee B-4, the new electronics group, having attained full committee status met, and effected organization. Although the group on cathodes, now designated subcommittee I of the new committee, will continue its work very much as it has in the past, there are certain organizational matters which must be cleared up and a steering committee for the subcommittee will meet prior to the fall meeting. Chairmen of other groups concerned with materials for electron tubes reported that there are several potential new tentatives which

probably will be ready for committee action by the fall meeting.

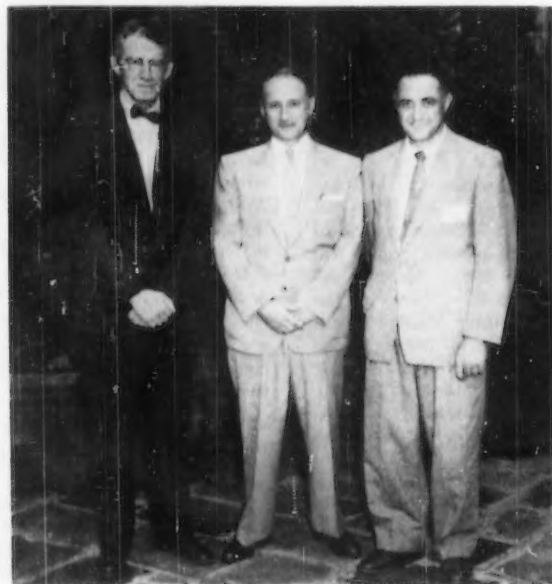
Two new groups were organized—on luminescent materials and on semiconductor metals. The organization of these two groups was of particular importance at this initial meeting of the committee.

Chairman Standing presided over the initial meeting attended by a number of invited representatives of producers and consumers of luminescent materials and others having a general interest. With respect to the characteristics of luminescent materials, it was suggested that initial efforts of the new group be directed toward development of test methods for particle size of phosphors used in cathode ray tubes, method of test for light output, and development of a standard tube of the demountable type to be used for evaluation work. It was the consensus that problems on this subject encompassed a large number of variables and intangibles and hence a long range view of possible accomplishments is desirable. It was indicated that the active participation of individuals close to the "line engineering phases" in this field is necessary for proper concepts of the problem and to permit successful programming. Awareness of the activities of the Joint Electron Tube Engineering Council, Institute of Radio Engineers, and the Electrochemical Society was expressed, but it was agreed that as long as the ASTM committee confines its activities

to the material aspects, including test methods and promotion of knowledge relating to tests and properties of materials, there was not likely to be any overlapping of activities. The opinion was expressed that members of these other organizations should be encouraged to participate in the ASTM activity and to provide liaison where applicable. An acting chairman and an acting secretary for the new subcommittee on luminescent materials were appointed with assignments to solicit additional participants and to promote the successful organization of the new subcommittee.

The initial meeting of the new Subcommittee VI to develop standards for semiconductor materials was well attended by representatives of producers, consumers, and general interest organizations. Particularly well represented were the electronics companies which are currently producing semiconductor devices and are therefore rated as consumers of semiconductor materials such as germanium, silicon, and selenium. The officers of Committee B-2 on Non-Ferrous Metals and Alloys were present by invitation because of their interest in the metallurgical aspects of the semiconductor metals as covered in the committee's scope. It was evident from the discussion that those present felt there is a definite need for standards for semiconductor materials and considerable interest in the project was shown.

It was brought out that the standardization problems associated with semiconductor metals are not strictly metallurgical and must be attacked by those concerned with the electronic applications of these materials. The metallurgists present indicated that contributions toward solution of the problems relating to development of standards for these materials could also be made by metallurgists. It was agreed that contributions could be made by both groups and, accordingly, acting chairman Frank Biondi indicated that he would appoint six members from among the producers, general interest, and consumer groups present and he would invite Committee B-2 to name three representatives from that committee to serve on a committee of nine to work out the initial program for standardization of semiconductor metals. It was suggested that the initial efforts be on germanium rather than silicon because of the relative simplicity of the germanium problems as compared with those of silicon. It was indicated that efforts should be made to secure more adequate representation of organizations interested in these materials.



Officers of the Newly Formed Committee F-1 on Materials for Electron Tubes and Semiconductor Devices are from left to right; Stanton Umbreit, Secretary; S. A. Standing, Chairman; and Frank J. Biondi, Vice-Chairman.

List of New and Revised Tentatives (with Serial Designations)

AT THE ANNUAL Meeting, the Society accepted 65 new tentatives and revisions in 161 former tentative specifications and methods of test. Of the revised tentative specifications and methods of test 34 have been extensively revised, the titles of which (marked with an asterisk) are given below, together with the list of those issued by the Society for the first time. Thirty standards have been revised and reverted to tentative status. Designations of technical committees responsible for the various items are indicated after the boldface materials headings.

Steel (A-1)

Specifications for:

- Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 387 - 55 T)
- Alloy Steel Castings Normalized and Drawn for High Pressure and Elevated Temperature Service (A 389 - 55 T)
- Alloy Steel Chain (A 391 - 55 T)

Recommended Practice for:

- Ultrasonic Testing and Inspection of Heavy Steel Forgings (A 388 - 55 T)

Cast Iron (A-3)

Specifications for:

- * Foundry Pig Iron (A 43 - 55 T)
- * Chilled and White Iron Castings (A 360 - 55 T)

Corrosion of Iron and Steel (A-5)

Specifications for:

- Zinc-Coated Steel Chain-Link Fence Fabric (A 392 - 55 T)
- * Zinc-Coated (Galvanized) Iron or Steel Sheets, Coils and Cut Lengths (A 93 - 55 T)
- * Zinc-Coated (Galvanized) Iron or Steel Tie Wares (A 112 - 55 T)
- * 1.25 oz Ordered Coating (Pot Yield) Zinc-Coated (Galvanized) Iron or Steel Roofing Sheets (A 361 - 55 T)

Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys (A-10)

Recommended Practice for:

- Conducting Acidified Copper Sulfate Test for Intergranular Attack in Austenitic Stainless Steel (A 393 - 55 T)

Wires for Electrical Conductors (B-1)

Specifications for:

- Silver-Coated Soft or Annealed Copper Wire (B 298 - 55 T)

Non-Ferrous Metals and Alloys (B-2)

Specifications for:

- Titanium Sponge (B 299 - 55 T)
- * Fire-Refined Casting Copper (B 72 - 55 T)

Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts (B-4)

Method of Test for:

- Interface Impedance Characteristics of Vacuum Tube Cathodes (B 300 - 55 T)

Copper and Copper Alloys (B-5)

Specifications for:

- Tellurium Copper Rod (B 301 - 55 T)
- Threadless Copper Pipe (B 302 - 55 T)

Light Metals and Alloys (B-7)

Specifications for:

- * Aluminum Bars for Electrical Purposes (Bus Bars) (B 236 - 55 T)

Metal Powders and Metal Powder Products (B-9)

Specifications for:

- Copper Infiltrated Iron Parts (B 303 - 55 T)
- * Metal Powder Sintered Bearings (Oil Impregnated) (B 202 - 55 T)

Cement (C-1)

Specifications for:

- Slag Cement (C 358 - 55 T)

Method of Test for:

- False Set of Portland Cement (C 359 - 55 T)

Concrete and Concrete Aggregates (C-9)

Method of Test for:

- Ball Penetration in Fresh Portland Cement Concrete (C 360 - 55 T)
- * Air Content (Volumetric) of Freshly Mixed Concrete (C 173 - 55 T)
- * Fundamental Transverse and Torsional Frequencies of Concrete Specimens (C 215 - 55 T)

Concrete Pipe (C-13)

Specifications for:

- Reinforced Concrete Low-Head Pressure Pipe (C 361 - 55 T)
- Reinforced Concrete Low-Head Internal Pressure Sewer Pipe (C 362 - 55 T)

Thermal Insulating Materials (C-16)

Specifications for:

- Molded Cork Pipe Insulation for Low Temperatures (C 339 - 55 T)
- * Structural Insulating Board Made from Vegetable Fibers (C 208 - 55 T)
- * Mineral Wool Felt Insulation (Industrial Type) (C 264 - 55 T)

Methods of Testing:

- * Structural Insulating Board Made from Vegetable Fibers (C 209 - 55 T)

Structural Sandwich Constructions (C-19)

Methods of Test for:

- Delamination Strength of Honeycomb Type Core Material (C 363 - 55 T)
- Edgewise Compressive Strength of Flat Sandwich Construction (C 364 - 55 T)
- Flatwise Compressive Strength of Sandwich Cores (C 365 - 55 T)
- Measurement of Thickness of Sandwich Cores (C 366 - 55 T)

Acoustical Materials (C-20)

Methods of Test for:

- Strength Properties of Prefabricated Architectural Acoustical Materials (C 367 - 55 T)

Ceramic Whiteware and Similar Products (C-21)

Methods of Test for:

- Impact Resistance of Ceramic Tableware (C 368 - 55 T)
- Modulus of Rupture of Fired Cast or Extruded Whiteware Products (C 369 - 55 T)
- Moisture Expansion of Fired Whiteware Products (C 370 - 55 T)
- Sieve Analysis of Non-Plastic Pulverized Ceramic Materials (C 371 - 55 T)
- Linear Thermal Expansion of Fired Whiteware Products by the Dilatometer Method (C 372 - 55 T)
- Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Porous Whiteware Products (C 373 - 55 T)

Porcelain Enamel (C-22)

Methods of Test for:

- Fusion Flow of Porcelain Enamel Frits (Flow-Button Method) (C 374 - 55 T)

Classification of:

- Water Used in Milling of Porcelain Enamel (C 375 - 55 T)

Paint, Varnish, Lacquer, and Related Products (D-1)

Methods of Test for:

- Spectrophotometric Diene Value of Dehydrated Castor Oil and Its Derivatives (D 1358 - 55 T)
- No-Smear Time of Traffic Paint (D 1359 - 55 T)
- Fire Retardency of Paints (Cabinet Method) (D 1360 - 55 T)
- Fire Retardency of Paints (Stick and Wick Method) (D 1361 - 55 T)
- Alcohol in Methyl Isobutyl Ketone (D 1362 - 55 T)
- Permanganate Time of Lacquer Solvents and Diluents (D 1363 - 55 T)
- Water in Lacquer Solvents and Diluents (Fischer Reagent Titration Method) (D 1364 - 55 T)
- Color Difference using the Hunter Color Difference Meter (D 1365 - 55 T)
- * Tinting Strength of White Pigments (D 332 - 55 T)
- * Consistency of Exterior House Paints and Enamel-Type Paints (D 562 - 55 T)

Recommended Practice for:

- Reporting Particle Size Characteristics of Pigments (D 1366 - 55 T)

Petroleum Products and Lubricants (D-2)

Methods of Test for:

- Lubricating Qualities of Graphites (D 1367 - 55 T)
- Trace Concentrations of Tetraethyllead in Primary Reference Fuels (D 1368 - 55 T)
- * Aniline Point and Mixed Aniline Point of Petroleum Products and Hydrocarbon Solvents (D 611 - 55 T)
- * Olefinic Plus Aromatic Hydrocarbon

in Petroleum Distillates (D 1019 - 55 T)

*Sulfur in Petroleum Products and Liquefied Petroleum Gases by the CO₂ Lamp Method (D 1266 - 55 T)

Road and Paving Materials (D-4)

Specifications for:

*Crushed Stone, Crushed Slag, and Gravel for Single, Double or Multiple Bituminous Surface Treatments (D 1319 - 55 T)

Recommended Practice for:

Quantities of Materials for Bituminous Surface Treatments (D 1369 - 55 T)

Paper and Paper Products (D-6)

Methods of Test for:

*Resistance of Paper to Passage of Air (D 726 - 55 T)

*Fiber Analysis of Paper and Paperboard (D 1030 - 55 T)

Wood (D-7)

Specifications for:

*Creosoted End-Grain Wood Block Flooring for Industrial Use (D 1031 - 55 T)

Methods of:

*Static Tests of Wood Poles (D 1036 - 55 T)

*Alpha-Cellulose in Cellulosic Materials (D 1103 - 55 T)

Bituminous Waterproofing and Roofing Materials (D-8)

Method of Test for:

Contact Compatibility of Bituminous Materials (D 1370 - 55 T)

Electrical Insulating Materials (D-9)

Method of:

Cleaning Plastic Specimens for Insulation Resistance Testing (D 1371 - 55 T)

*Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies (D 149 - 55 T)

*Varnished Cloths and Varnished Cloth Tapes Used for Electrical Insulation (D 295 - 55 T)

*Pressure-Sensitive Adhesive Tapes Used for Electrical Insulation (D 1000 - 55 T)

Shipping Containers (D-10)

Methods of Testing:

Package Cushioning Materials (D 1372 - 55 T)

Rubber and Rubber-Like Materials (D-11)

Specifications for:

Ozone-Resistant Rubber Insulating Tape (D 1373 - 55 T)

Methods of Test for:

*Adhesion of Vulcanized Rubber to Metal (D 429 - 55 T), Method B

Soaps and Other Detergents (D-12)

Methods of:

Analysis of Sodium Triphosphate (D 501 - 55 T)

Aerated Total Immersion Corrosion Test for Metal Cleaners (D 1374 - 55 T)

Textile Materials (D-13)

Methods of Test for:

Pilling Propensity of Textile Fabrics (D 1375 - 55 T)

Warp Knit Fabrics (D 1376 - 55 T)

Wide Elastic Fabrics (D 1377 - 55 T)

Absorbency Time and Absorptive Capacity of Nonwoven Fabrics (D 1378 - 55 T)

Abrasion Resistance of Textile Yarns (D 1379 - 55 T)

Fineness of Cotton Fibers by Resistance to Air Flow (Arealometer) (D 1449 - 55 T)

Maturity of Cotton Fibers (Polarized Light Method) (D 1450 - 55 T)

*Fineness of Wool (D 419 - 55 T)

*Fiber Length of Wool (D 519 - 55 T)

*Abrasion Resistance of Textile Fabrics (D 1175 - 55 T), Methods A and D

Specifications and Tests for:

Fineness of Mohair Tops (D 1381 - 55 T)

*Fineness of Wool Tops (D 472 - 55 T)

Adhesives (D-14)

Methods of Test for:

Susceptibility or Dry Adhesive Films to Attack by Roaches (D 1382 - 55 T)

Susceptibility of Dry Adhesive Films to Attack by Laboratory Rats (D 1383 - 55 T)

Engine Antifreezes (D-15)

Procedure for:

Glassware Corrosion Test for Engine Antifreezes (D 1384 - 55 T)

Industrial Water (D-19)

Method of Test for:

Hydrazine in Industrial Water (D 1385 - 55 T)

Methods of Testing (E-1)

Methods of Test for:

Indentation Hardness of Metallic Materials by Means of Portable Hardness Testers (E 110 - 55 T)

Determination of Young's Modulus at Room Temperature (E 111 - 55 T)

*Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials (E 18 - 55 T)

Fire Tests of Materials and Construction (E-5)

Methods of:

Fire Tests of Roof Coverings (E 108 - 55 T)

*Fire Tests of Door Assemblies (E 152 - 55 T)

Methods of Testing Building Constructions (E-6)

Methods of:

*Conducting Strength Tests of Panels for Building Construction (E 72 - 55 T), Method B

Non-Destructive Testing (E-7)

Method for:

Dry Powder Magnetic Particle Inspection (E 109 - 55 T)

Plastic-Pipe Standards

THE joint ASTM-SPI Committee on Plastic Pipe, functioning as a subcommittee of Committee D-20 on Plastics, was organized in 1954 to develop standards for plastic pipe. Data upon which to base the standards work are being obtained from several research projects sponsored by the Society of the Plastics Industry.

About the same time this committee was organized, the American Standards Assn. took official cognizance of the need for standards in this area and established Subcommittee 12 on Nonmetallic (Plastic) Pipe Fittings of ASA B 16 on Pipe Flanges and Fittings. Chairman of Subcommittee 12 is R. C. Thumser who is also the ASTM representative on the Chemical Industry Advisory Board, advisory to the ASA. Subcommittee 12 is concerned with dimensional standards for plastic fittings but for materials standards, the committee looks to ASTM.

On the subject of plastic pipe, the ASA has held several exploratory conferences over the past year during which the existing standardization effort in this area was discussed. Finally, at a general conference on Plastic Pipe held under ASA auspices on May 5, it was the consensus of those present that a sectional committee on dimensions for plastic pipe is needed. The SPI requested sponsorship of the sectional committee with ASME as co-sponsor. ASTM will, of course, be represented. Organization of the sectional committee will serve to represent all interests in the establishment of plastic pipe dimensions and in the coordination with dimensions of other kinds of pipe and fittings. The work of the ASTM-SPI joint committee will continue as originally planned and any dimensional standards developed by the committee will be submitted via the sectional committee to the ASA.

Red Face Department

In the May BULLETIN, Technical Committee Notes on page 39, there was an unfortunate error in the report of the symposium sponsored by Committee D-20 on Plastics. The author of the paper on "Dynamic Modulus Measurements by the Vibrating Reed Method" was Stephen Strella, U.S. Department of the Army, Picatinny Arsenal, instead of G. R. Rugger as indicated. Our apologies to Mr. Strella.

Mr. Strella's paper has been submitted for publication in the BULLETIN.

Materials Research in ASTM

By H. H. Lester

This paper has been prepared by a member of the Administrative Committee on Research on behalf of that committee and is presented with the hope of stimulating thought and discussion about the ways and means of fulfilling one of the Society's main purposes—materials research.

ASTM is, has been, and, it is hoped, will continue to be devoted broadly to the interests of applied scientists, including engineers and others who invent and develop the designs for the machines and structures used by society and, with similar breadth, the interests of the manufacturers and consumers of those products.

The stated purposes of the Society are:

- (a) The promotion of the knowledge of materials of engineering, and
- (b) The standardization of specifications and the methods of testing.

The first-named purpose always has been recognized as of great importance; however, to many—perhaps to most members—the knowledge of materials has been associated intimately with specification requirements and the “promotion” of such knowledge with how to make materials that would better meet those requirements. In this way, it has been more or less directly associated with problems of production. The second purpose is obviously directly associated with production and serves the objectives of successful manufacture. Both purposes are necessary services to industry that ASTM is peculiarly fitted to supply and has supplied so ably over the years of its history.

There is another aspect to “knowledge of materials” that has not been so clearly recognized and certainly not so much emphasized. This aspect regards “knowledge of materials” as a stimulus to design invention and improvement. It involves fundamental materials research, or, to conserve wordage, simply “materials research” as used in this paper. Thoughtful consideration indicates for it tremendous significance. It looks to the future, of course, but in the long run could outweigh in ultimate importance many aspects of materials knowledge that are of immediate value to manufacture and design. This paper attempts to point out the significance of this type of research.

Importance of Properties of Materials

In order to develop this subject properly, it is necessary to consider some generalities. The idea for a mechanism may be inspired by a desire to make useful application of some observed

property or properties of materials, or it may be inspired by the desire to make useful application of some aspect of scientific knowledge. For design originating from the first source, the importance of materials is obvious, for that originating from the second, the importance of materials becomes evident on considering the development of the design concept from its genesis to its practical utilization. The steps are:

Conception → Realization → Utilization

These terms have these significances:

Conception—The concept of a mechanical design¹ is at first a mental image in the mind of the conceiver. As such, it has no physical reality, no material existence, and no practical utility.

Realization—To be useful, the mental image must be realized; that is, it must be reproduced in physical substance (or substances) having properties that permit the visualized functioning of the conception. If no such substance (or substances) exists, the concept cannot be realized. In any case, it can be realized *only to the extent permitted by the properties of the materials used in the construction of the reproduction.*

Utilization—Utilization, that is, the making of the concept practically useful, depends upon the availability of suitable materials whose properties permit adequate realization of the design concept, the more varied the properties, the more complex the design that can be realized; the higher the values of the properties, the more powerful the design.

From the above, the vital importance of materials or, more specifically, the properties of materials, becomes apparent. They are the media through which concepts are translated from the world of imagination to the world of physical reality; they are the means of making scientific knowledge mechanically useful; they are the *sine qua non* of the engineer.

¹ Probably the mechanism or structure is visualized rather than the skeletonized representation of it often referred to as the “design.” In this paper it is convenient to use the term design to represent the mechanism or structure.

Problems of Materials Research

The growth in variety and complexity of the mechanisms of industry that have resulted from improvements in design and from the challenge of new scientific discovery require ever increasing quantities of new materials with new and more varied properties. It is not probable that these new materials will be found by accidental discovery; they must be supplied by far-reaching investigative studies such as are envisaged in materials research, the broad problems of which are obviously: (a) the discovery of new properties in presently known materials,² (b) the discovery or development of new materials having new properties, and (c) the development of materials properties to more desirable values.

Urgency of the Need for Materials Research

Design concepts today are considerably ahead of materials development. For many types of mechanisms, further design development is seriously handicapped by inadequacies of presently available materials. There are needed, to illustrate by only a few examples, stronger, tougher, more enduring metals for the weapons of national defense; materials that will perform adequately at elevated temperatures for gas turbines and jet engines; materials of higher strength to weight ratios and other pertinent properties for airplane construction and for other types of mobile mechanisms, materials to replace those in critical shortage and those that could be unavailable in time of war. Rapidly expanding technological advances impose additional burdens on the materials of the near future that should be anticipated in the research of today.

Design and Materials

Mechanistic design may be regarded as a geometric arrangement of materials whereby their properties are utilized to realize the visualized functioning of the design. The concept of the design may

² “Materials” as used in this paper refers to any or all materials that enter into construction of mechanism or structure. They include not only chemical elements but also compounds, mixtures, alloys, or any combination of them, including liquids or gases, that are essential to the construction of the design. “Materials properties” refer to any or all characteristics that can be used in the functioning of the design.

I have been inspired by a desire to make useful application of observed properties of the material, or of some aspect of scientific knowledge, possibly a new scientific discovery. Whatever the motivation, the design is an instrument by means of which scientific principles are made mechanically useful.

Design has two aspects, one is its geometrical pattern, the other is its material substance. Both aspects are essential to its functioning. It is possible, human ingenuity being what it is, to develop the geometrical aspect to near perfection; but even assuming this perfection, the functioning of the design is still controlled by the materials aspect and cannot exceed limits set by the properties of the materials. This fact indicates the vital importance to design of materials, or rather the properties of materials. It is through them that design operates to make science mechanically useful. There appears to be no other way to achieve this end except through the medium of mechanistic design, and design cannot achieve its purpose except through the utilization of materials properties.

Sources of Design

As indicated in a previous paragraph, mechanistic design may be inspired from two sources; one, the desire to make scientific knowledge mechanically useful, the other, the desire to make observed materials properties mechanically useful.

Design motivated from the first source is to a large extent the design furnished by professionals working in applied science who may be physicists, chemists, metallurgists, engineers, etc., and many, no doubt, with no particular professional training. These contributors are concerned with obtaining better materials to implement or to make possible the realization of design concepts whose purpose is to render scientific knowledge practically useful. Design originating from such motivation has been possible only after the accumulation of scientific information but has grown fantastically with the amazing growth of science. The servicing of it with suitable materials is a major interest of ASTM.

The second inspirational source of design invention has stimulated the creative genius of men through the ages. It has inspired the trained professional and the man of no particular education alike. It has been responsible for most of the simple structures and mechanisms that have served everyday living, and also for many of the advanced mechanisms of industry, even those complicated ones found in present manufacture.

ASTM and Design

Design once invented whatever the inspirational source, suitable materials are needed for further development of it. ASTM has rendered outstanding service in providing those materials. The Society serves industry at design-development and production levels. It provides standards of quality for the materials that enter into functional design; the tests whereby those standards can be achieved and maintained in manufacture; and the specifications which instruct the manufacturer with regard to materials for specific items or classes of items. Such service is indispensable to industry.

However, in the above service, the Society has acted to implement design development rather than to inspire it, inspiration having come either from the stimulus of science or from the stimulus of the materials themselves. This inspirational aspect of materials has been a preponderating stimulus to invention, at least in the earlier stages of the development of civilization. It is potent even today. For example, the stone knife has been claimed as the first great invention. Obviously, it originated in a desire to make useful application of the observed cutting property of sharp stones. Similarly, the first mariner's compass was undoubtedly inspired by the observed north-seeking property of lodestone at a time when nothing was known about magnetism nor of the earth's magnetic field. Inventions of succeeding periods, to a very great extent, have been attempts to exploit observed materials properties. The present potency of the stimulus is illustrated by such things as the exploitation of germanium whose peculiar electrical properties have inspired a large family of mechanistic inventions leading to better hearing aids, more compact radio receivers, etc.; and the exploitation of the piezo-electric properties of quartz crystals which has given rise to another family of devices, among them the "walkie-talkie." It has always been true that new or improved materials properties have been prolific in producing new design.

It would appear that more advantage should be taken of this natural challenge of materials. Perhaps one of the great services that could be rendered to industry would be the providing of materials with new or improved properties that would inspire the inventive genius of engineers and other creative thinkers working in applied science.

ASTM and Materials Research

ASTM serves well in the implementation of design development. Should it broaden its service to include some

portion of design creation by providing new materials whose properties would attract the attention of creative designers? It could do this by extending its efforts in materials research.

New materials and new properties of known materials have come as by-products of researchers in pure science whose objectives have not been concerned primarily with the properties of materials, and from the efforts of more or less practical minded professionals in various fields who have been seeking definitely new or improved materials for particular types of application. The chemists have been especially prolific, but there have been important contributions from most branches of science and engineering. The list of new materials produced in recent years would be a very long one. There have been new steels, new non-ferrous metals and alloys, new ceramics, new plastics, a great variety of chemical products, and others. Many of these products have been competing among themselves and with older products. Each material, seeking to gain a foothold in industry, has accomplished this end by earnest and usually honest advertising of its particular merits. This system has been effective in providing better materials, but it is subject to the criticism that, except for the accidental by-products of scientific research, the new materials have been produced, not to stimulate design invention, but to implement established design. They have been largely those for which a potential commercial market existed and for which there were promises of more or less immediate financial profit.

Since in our free-enterprise type of society, a company must either produce profits or die, the objection pointed out above indicates a situation that is inevitable. The situation does present an opportunity, however, for ASTM to serve industry by promoting materials research, the objectives of which would be the providing new or improved materials without consideration of immediate application or immediate profit and whose use to implement established design would be incidental. ASTM, in its comprehensive organization, covers most, if not all, of the construction materials. It also, in its committed organization, brings together representatives of most of the organizations who are vitally interested in using those materials in design invention and development, in manufacture, and in using the final product. Because of its very broad coverage, the Society represents materials on an industry-wide scale. Since the general problems of materials research are industry-wide and not restricted to any specialized

branch of industry, it would seem that ASTM is in a peculiarly favorable position to render the valuable service to industry represented by materials research.

The extension of the Society's activities to include greater attention to the promotional work indicated above would involve no important organizational changes. It would involve, probably, some additions to existing committees to take care of responsibilities associated with the materials research of interest to the individual committee; it could mean the setting up of subcommittees representing colleges, universities, and research institutions where investigative studies in materials are being performed; it could mean the organization of a survey committee whose responsibility would be to a point out probable fruitful fields for investigation; it could mean sponsoring by the Society of promising materials-research projects, including the provision of funds. Whatever form the Society's service might take, the possibility of such service merits thoughtful consideration. The end to be achieved is a worthy one.

NEW ASTM PUBLICATIONS

Chemical Compositions and Rupture Strengths of Super-Strength Alloys

This compilation lists the name, nominal chemical composition, characteristic rupture strengths for rupture in 100 and 1000 hr, and patentee for 100 domestic and 41 foreign alloys. It does not include the conventional ferritic, martensitic, or austenitic stainless steels.

The data were prepared for Subcommittee XII on Specifications for High-Temperature, Super-Strength Alloys of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys by a task group consisting of Ward F. Simmons, chairman, V.

N. Krivobok, N. L. Mochel, and Russell Franks.

The subcommittee emphasizes the point that they do not recommend that the data in this compilation be used for design purposes, since the creep and rupture strengths of the "superalloys" are as dependent upon processing and heat treatment as upon chemical composition.

It is the intention of the subcommittee that this compilation be kept up to date by revising it at regular intervals, probably yearly.

Copies can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa. Price: 75 cents; to members, 60 cents.

Compilation on Glass

The third edition of the compilation of ASTM Standards on Glass and Glass Products presents standard and tentative specifications and methods of test sponsored by ASTM Committee C-14 on Glass and Glass Products.

This publication also includes certain selected specifications and test methods pertaining to the glass industry and prepared by other of the Society's technical committees.

The 22 standards cover glass and glass containers, glass block and insulation, glass insulators, and glass textiles.

Copies of this compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa. Price: \$1.15; to members, 90 cents.

Erratum

In the recently published 1954 Index to ASTM Standards, Tentative Specifications for Aluminum-Base Alloy Sand Castings (B 26) and Tentative Specifications for Aluminum-Base Alloy Permanent Mold Castings (B 108) are listed in error with the designation "52 T" indicating that their latest revision was made in that year. Since both Specifications were revised in 1954, their designation should appear as B 26 - 54 T and B 108 - 54 T respectively.

The listing of these Specifications in the Numeric Sequence in the Index is correct.

Annual Meeting Papers Available

CERTAIN of the papers not preprinted for the 1954 Annual Meeting were made available in mimeographed form primarily for the use of those interested in presenting discussion. Some of the members may be interested in securing copies in advance of their appearance in the *Proceedings* or *Special Technical Publications*. A limited number of copies of some of these papers are still available at a nominal charge.

Notched-Bar Testing—Theory and Practice—S. L. Hoyt, Metallurgical Consultant

Automatic Impact Testing to -236 C—Thomas S. DeSisto, Watertown Arsenal

The Influence of Pendulum Flexibilities on Impact Energy Measurements—J. I. Bluhm, Watertown Arsenal

Shock Tester for Shipping Containers—W. H. Cross and Max McWhirter

Pressure Distribution Along Friction Piles—L. C. Reese, Mississippi State College, and H. B. Seed, University of California

Relationship Between Soil Moisture Tension Values and the Consistency Limits of Soils—Ralph L. Rollins and D. T. Davidson, Iowa State College

The Use of Laboratory Tests to Develop Design Criteria for Protective Filters—K. P. Karpoff, Bureau of Reclamation

Resistance of Concrete to Fire and Radiation (Including Jet-Aircraft Blast)—Perry H. Petersen, U. S. Naval Civil Engineering Research and Evaluation Laboratory

Needed Research on Concrete and Concrete Aggregates—A. T. Goldbeck, National Crushed Stone Assn.

The Influences of Water Composition on Corrosion in High-Temperature, High Purity Water—D. M. Wroughton, J. M. Seamon, and P. E. Brown, Westinghouse Electric Corp.

The Resistance of Aluminum-Base Alloys to 20-Year Atmospheric Exposure—C. J. Walton and William King, Aluminum Company of America

Galvanic Couple Corrosion Studies by Means of the Threaded Spool and Wire Test—K. G. Compton and A. Mendizza, Bell Telephone Laboratories, Inc.

Effect of Speed of Testing on Tensile Strength and Elongation of Paper—Ralph E. Green, Thwing-Albert Instrument Co.

Effect of Speed in Plastics Testing—F. J. McGarry and Albert G. H. Dietz, Massachusetts Institute of Technology

Effect of Speed in Mechanical Testing of Concrete—J. J. Shideler and Douglas McHenry, Portland Cement Assn.

A Philosophy of Loading Tests for Structures—W. R. Schriever and D. B. Dorey, Division Building Research, National Research Council of Canada

The Fatigue Properties of Wrought Phosphor Bronze Alloys—G. R. Gohn, J. P. Guerard, Bell Telephone Labs., Inc., and H. S. Freynik, Riverside Metal Co.

Effect of Alloy Content on the Metallographic Changes Accompanying Fatigue—M. S. Hunter and W. G. Fricke, Jr., Aluminum Company of America

Axial Stress Fatigue Strengths of Several Structural Aluminum Alloys—F. M. Howell and J. L. Miller, Aluminum Company of America



JULY 1955

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Unheralded Service

SOMETIME someone may be able to evaluate approximately the amount of service given by many members and committee members of the Society, aside from their usual ASTM responsibilities. The services are many and varied.

We have in mind, for example, the large number of inquiries which are received regularly from companies and individuals asking legitimate advice in relation to sources of equipment, unusual problems, requirements for materials that have not been standardized, etc. A great many of these must be referred to officers of our technical committees, and the wheels of industry certainly turn more smoothly because of the frequent help that they give in their capacity as committee officers. We always keep in mind that neither ASTM nor its people are in the business of giving testing, research, or consulting advice, which normally should be procured on a fee basis.

Unheralded are the reviewers of technical papers who frequently must have misgivings about the drastic comments that they must make in the interest of not only the author but the audience and later the reader.

There are a great many special ASTM committees which aside from a listing in the Year Book are seldom noted in our news columns. The Award Committees are examples. The Award of Merit Committee must meet many hours and review extensive reports. Considerable time must be spent by the individual members of other Award Committees on papers and technical contributions.

While the Society officers themselves have received recognition and honor, only Staff members or fellow Directors can appreciate the time and effort involved in advising and deciding on administrative problems. Perhaps the "poor" President is unique in his con-

tribution because it usually involves a minimum of at least nine years' service on the Board, and some have had eleven. Lest any alert top executive feel that the proportion of company time used in some of this work does not help his company pay dividends, let it be recorded that every ASTM committee member and officer we have met testifies to the value of his ASTM contacts as well as to the enjoyment of them. And every committee officer devotes some of his own personal time and effort to the Society.

There is a noteworthy example covered in the news columns of this BULLETIN where leading authorities in the field of testing metals did an accelerated but thorough and intensive job in reviewing the widely used Federal Speci-

fications for Testing Metals. Many of the comments received were of an extremely important nature, and will improve this document which is so significant to industry. Most of this work tends to improve industrial operations.

The whole philosophy of ASTM's great service to industry and Government is one of sharing and of a great amount of unselfish contribution. We are sorry we cannot always express directly and in sufficient measure the thanks for these unheralded services. We are confident the satisfaction of having made the contributions very frequently provides much gratification.

We Will Buy—

Your Part 1, 1952 Book of ASTM Standards

Since Part I of the new 1955 Book of Standards is scheduled to appear in October, it is hoped that some members will be willing to part with their Part I of the 1952 Book. If your copy is in reasonable condition for resale, we will buy it back at \$4 upon its receipt at ASTM Headquarters. Be sure a return address is on the package to enable identification and, better still, advise that shipment is being made.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
September 14	Committee D-22 on Methods of Atmospheric Sampling and Analysis	Minneapolis, Minn.
September 22-23	Committee D-10 on Shipping Containers	New York, N. Y. (Hotel Statler)
September 29	Committee C-21 on Ceramic Whiteware and Similar Products	Bedford, Pa. (Bedford Springs Hotel)
October 3-4	Committee C-1 on Cement	Montreal, Quebec (Laurentian Hotel)
October 4-6	Committee B-5 on Copper and Copper Alloys, Cast and Wrought	Philadelphia, Pa. (Society Headquarters)
October 5-6	Committee C-22 on Porcelain Enamel	Pittsburgh, Pa. (Mellon Inst.)
October 6	Committee C-8 on Refractories	Bedford, Pa. (Bedford Springs Hotel)
October 6-7	Committee C-9 on Concrete and Concrete Aggregates	Montreal, Quebec (Laurentian Hotel)
October 18-21	Committee D-13 on Textile Materials	New York, N. Y. (Park Sheraton)

Second Pacific Area Meeting in 1956 Shaping Up Under General Committee on Arrangements

PLANNING for the Second Pacific Area National Meeting has moved ahead rapidly, promising a large and technically varied program and a big exhibit of laboratory apparatus and testing equipment.

W. C. Hanna, *Honorary Chairman*
Calif. Portland Cement Co.

Honorary Vice-Chairmen

W. M. Barr (retired)
P. V. Garin, Southern Pacific Co.
H. P. Hoopes, Pabco Products, Inc.
E. O. Slater, Smith-Emery Co.
C. M. Wakeman, *Chairman*
Los Angeles Harbor Dept., P. O. Box 786, Wilmington
E. O. Bergman, *Vice-Chairman*
C. F. Braun Corp., Alhambra
T. Parker Dresser, Jr., *Vice-Chairman*
Abbot A. Hanks, Inc., 624 Sacramento St., S. F. 11
M. B. Niesley, *Secretary*
Calif. Testing Labs., Inc., 619 E. Wash. Blvd., L. A. 15
Byron Weintz, *Treasurer*
Consolidated Rock Products Co., 2950 Terminal Annex L. A. 54

Subcommittee Chairmen

Finance

Byron Weintz, *Chairman*
L. A. O'Leary, *Vice-Chairman*
W. P. Fuller and Co., South S. F.

Technical Program

P. James Rich, *Chairman*
Harvey Machine Co., Inc., 19200 S. Western Ave., Torrance
R. E. Davis, *Vice-Chairman* University of California, Berkeley 4

Social

E. R. Millett, Jr., *Chairman*
California Natural Gasoline Assn., 510 W. 6th St., L. A. 14
C. E. P. Jeffreys, *Vice-Chairman*
Truesdail Labs., Inc., 4101 N. Figueroa St., L. A.

Transportation

C. W. Beardsley, *Chairman*
City of L. A., Bur. of Stds., 826 Yale St., L. A. 12
Guy Corfield, *Vice-Chairman*
Southern California Gas Co., Box 3249, Term. Annex, L. A. 54

Hotels

R. B., Stringfield, *Chairman*
229 S. Normandie Ave., L. A. 4
D. E. Bowers, *Vice-Chairman*
Gen. Petroleum Corp. of Calif., Box 2122, Term. Annex., L. A. 54

Information

E. F. Green, *Chairman*
Axelson Mfg. Co., Box 58335 Vernon Sta., L. A. 58
F. J. Robbins, *Vice-Chairman*
Sierra Drawn Steel Corp., 5821 E. Randolph St., L. A. 22

Promotion and Publicity

Bert Folda, *Chairman*
General Petroleum Corp., Box 2122, Term. Annex, L. A. 54
T. K. Cleveland, *Vice-Chairman*
Phila. Quartz Co. of Calif., 6th and Grayson Sts., Berkeley 10

Plant Visits

F. B. Doolittle, *Chairman*
Southern California Edison Co., Edison Bldg., L. A. 53
Harry Welch, *Vice-Chairman*
Western Precipitation Corp., 1016 W. 9th St., L. A. 15

Industry Luncheons

L. L. Whiteneck, *Chairman*
Long Beach Harbor Dept., 1333 El Embarcadero, Long Beach
C. R. Baker, *Vice-Chairman*
Pacific Tube Co., 5710 Smithway, L. A.

Liaison Committee

Personnel consists of the Honorary Officers

Coordinating Committee on Cellular Materials to Be Organized

TECHNOLOGICAL developments in recent years have greatly increased the number and variety of products falling in the category of cellular materials. Though cellular materials, such as wood and marine sponge, have been with us for a long time it is only in relatively recent times that synthetic sponge has been developed as a major competitor for marine sponge, in the form of many varieties of foamed and sponge rubber, foamed plastics (rigid and flexible) and even foamed glass. Also, a new product, recently publicized, is a sprayed-on foam applied by surface coating techniques.

These cellular materials adapt themselves to a variety of applications. Many of the flexible ones of both rubber and plastics are finding their way into cushioning applications such as automotive seating and arm rests, mattresses, pillows, sofas, and chairs. The more rigid cellular materials are used for thermal insulation, cores for sandwich construction, gaskets and seals, flotation, electrical insulation, and even for novelties and advertising displays.

With such a variety of uses, it is not surprising that a number of ASTM committees have become involved in standardization work on these materials. In order to discuss this community of interest a meeting was held on March 25 of representatives of several of the ASTM technical committees. From the discussions at the meeting it was recommended that the Society establish a "Coordinating Committee on Cellular Materials" for the purposes of allocating activities on a basis of mutual consent to the various committees and to correlate and facilitate the exchange of information among the committees concerned. Each committee having an interest in this area will have the opportunity of representation.

The recommendation to establish the Coordinating Committee was approved in May by the Directors of the Society. Following the naming of representatives, an organization meeting will be called, probably within the next few months.

Second Lubrication Conference

THE Second Lubrication Conference, sponsored jointly by the Lubrication Activity Group of The American Society of Mechanical Engineers and the American Society of Lubricating Engineers, will be held October 10-12 at the Antlers Hotel, Indianapolis, Ind.

Sessions are planned on (1) Bearing Instability, (2) Recent Studies in Hydrodynamic Lubrication, (3) Lubricants, (4) Rolling Contact Bearings, and (5) Boundary Lubrication.

District Activities

PHILADELPHIA

ONE of the most successful meetings in the history of the ASTM Philadelphia District was held on Tuesday, April 12, at the Franklin Institute.

The "Meeting on Concrete" featured two well-known speakers discussing different phases of the concrete industry and was attended by 200 members and guests. Henry L. Kennedy, a consulting architect and engineer, and Sales Manager for Dewey & Almy Chemical Co., spoke on "Concrete Practices in Europe as Compared to the United States." His talk, based on observations and conferences during his recent trip to eight European countries, included a comparison of European and American practices and pointed out progress in concrete technology in the countries visited as well as their progress along other industrial lines. He included in his discussion a comparison of plastic versus zero-slump concrete as well as some interesting facts concerning some examples of 2000 yr-old concrete from the Bay of Pozzouli near Naples. A sample of this concrete was on display and drew a considerable amount of attention from the audience.

Stanton Walker's paper, "The Evaluation of Acceptance Tests for Concrete," included a discussion of the causes of variations in the test results for strength, consistency, and air content of concrete, as well as means for reducing these variations. The degree of reliability of properly made tests was pointed out along with a review of various approaches for determining the quality of concrete in the structure. He presented an appraisal of the Rebound Hammer Test which is a non-destructive method for determining the strength of concrete in place. Mr. Walker, a Past-President of the American Concrete Inst., is Director of Engineering for the National Ready Mixed Concrete Assn. and the National Sand and Gravel Assn. He was also a member of the ASTM Board of Directors from 1951 through 1954 and received an ASTM Award of Merit in 1951.

Both talks were enhanced by the lively discussion which followed them.

The speakers were introduced by W. J. McCoy, Director of Research, Lehigh Portland Cement Co., who had also served as the program chairman. Prior to the technical session, E. K. Spring, chairman of the Philadelphia District, introduced Executive Secre-

tary R. J. Painter, who spoke very briefly on the current work of the ASTM with particular reference to present problems involving titanium.

CLEVELAND-DETROIT

THE Cleveland and Detroit Districts welcomed President Mochel and Executive Secretary Painter at meetings held in Cleveland on April 20 and in Detroit on April 21. The Cleveland meeting was at the Hotel Manger (formerly Allerton) and Detroit as usual used the excellent facilities of the Rackham Memorial Building. There were about 50 present in Cleveland despite very wet weather and at Detroit upward of 200 at the dinner and possibly 250 in the lecture hall when the President spoke. District Chairmen L. F. Herron, President, The James H. Herron Co., and R. B. Saltonstall, Technical Director, The Udylyte Corp., presided at the meetings in Cleveland and Detroit respectively.

President Mochel's talk was along the lines of earlier District addresses, but in Detroit he brought in considerable information on stationary gas turbines and posed a series of questions on turbines for automobiles and trucks. In the latter case he noted some of the real problems involved such as fuel, safety precautions, length of service, that is, new parts requirements, and the like.

He noted that the stationary gas turbine unquestionably had an important place in installations up to a possible maximum of 15,000 kw, especially where fuel is either free or of very low cost. His illustrations of application included stationary and railway units (for the Corps of Engineers) multiple units in South American oil fields, and small water-borne troop carriers.

In Detroit, the coffee speaker was Harvey A. Wagner, Assistant Manager of Engineering, Detroit Edison Co., who for many years has been a very active ASTM worker, but is now concentrating in the atomic power field. He cited the element of competition as the atomic plant develops and noted the impetus that is being given as AEC releases authority to industry for development of plants. Some 60 leading utilities and combines are studying and developing plants, but other units in industry are also participating—boiler manufacturers, chemical companies, and electrical manufacturers. He noted

that the energy available from nuclear power is possibly 20 times that of all our mineral fuels. Early high costs can be justified from the development angle and future surety of an energy source.

The availability of materials is the key to the speed of development. High temperatures, resistance to corrosion, and oxidation resistances are important. Since the turbine will be the prime mover, essentially the same problems will be encountered, but there are new ones including those of irradiation, dislocation of lattice structure; tests must be made and this is another potent reason for having industrial development.

Mr. Warner said he felt sure ASTM would handle responsibilities in this as it has in other fields. He concluded with a quotation from the British Minister of Fuel and Power in a statement made to Parliament indicating that many of those concerned with American development subscribe to this philosophy:

Improved living standards both in advanced industrial countries like our own and in the vast underdeveloped countries overseas can only come about through the increased use of power. The rate of increase required is so great that it will tax the existing resources of energy to the utmost. Whatever the immediate uncertainties, nuclear energy will in time be capable of producing power economically. Moreover it provides a source of energy potentially much greater than any that exists now. The coming of nuclear power therefore marks the beginning of a new era.

As a leading industrial nation our duty, both to ourselves and to other countries, is to establish this new industry of nuclear energy on a firm foundation and to develop it with all speed. It is a major industrial development that will bring with it revolutionary changes in technique. We shall only learn the new techniques by pressing forward with the practical applications wherever we can and in spite of the many uncertainties surrounding each enterprise.

NEW ENGLAND

UNDER the auspices of the New England District, and the Engineering Department of the University of New Hampshire, an excellent meeting was held at Durham on Thursday, April 28. It was featured by a stimulating address on "Wood As an Engineering Material," by Past-President L. J. Markwardt, Asst. Director, Forest

Products Laboratory, Madison, Wis., and an interesting introductory talk by Lewis C. Swain, Professor of Forestry, University of New Hampshire, on "Management Problems of Forestry and Wood Utilization."

In his discussion of the economic problems and potential of wood industries in New Hampshire, Professor Swain pointed out that 84 per cent of the state's area is forest land. Highest in value for lumber and general uses is the white pine; other species of importance are spruce and balsam fir. Another softwood, Norway or red pine finds a ready market for utility poles.

The importance of the forest resource to the state is indicated by the fact that one out of every five citizens derives his income directly or indirectly from it, approximately \$100,000,000 a year arising from New Hampshire's woods.

Protection and enhancement of this valuable asset is provided small private owners by experienced county foresters and consulting foresters who make timber sales, supervise logging operations, and carry out management plans. Sound research programs provide a constant if moderate flow of invaluable information on all phases of forestry and in utilization of the products of this prime natural resource.

In his address patterned after his notable 1943 Edgar Marburg Lecture, Mr. Markwardt first referred to some of the interesting history of forestry in New England, for example, the widespread use in the early sailing days of large trees as ship masts, a crown having marked many of these for this exclusive use. Through the use of exhibits and samples, Mr. Markwardt noted some of the unusual developments and modified forms of wood—for example, in sandwich construction, in impregnated material, and many other applications. He noted the unusual housing structure built at Madison with different types of wood construction in the same building. Unique methods of fastening structural members were also shown.

Preceding the technical meeting, the New England District Council met at the very attractive Exeter Inn and reviewed a number of business matters including consideration of an Annual Meeting of the Society in Boston in 1958.

A large amount of credit for this excellent meeting goes to Daniel Cushing, who has been chairman of the District's Educational Committee. Working closely with him was Professor W. D. Clement, University of New Hampshire, and the other District officers: Chairman Carlton G. Latts, and Secretary R. W. Chadbourne. At the council meeting in Exeter there were two past-presidents—L. J. Markwardt and Prof.

H. J. Ball, Lowell Technological Institute—and honorary member Dr. H. H. Lester, past-chairman of the District and very active worker.

The meeting was held in the University's relatively new engineering building, a fine modern structure in which there was an interesting exhibit of wood products, and a film shown through the courtesy of Timber Engineering Co.

The New England District attempts to hold each year one or two meetings at some engineering school, thus acquainting the faculty, members, and students with the work of the Society. School representatives participate in arranging the meeting; the ASTM members present also gain a knowledge of the various school facilities.

PITTSBURGH

SOME 200 members of the Purchasing Agents Assn. of Pittsburgh and ASTM members heard ASTM Executive Secretary R. J. Painter speak on "Standards—An Effective Aid to Purchasing," at the joint meeting on Tuesday, May 17, at the University Club. The meeting was co-sponsored by the Standards Committee of the purchasing group, and the great preponderance of attendance was from the purchasing agents.

T. O. English, Asst. General Purchasing Agent, The Aluminum Co. of America, president of the purchasing group presided. The speaker was introduced by H. G. Cranston, Director of Materials, The John F. Casey Co., who is chairman of the Standardization Committee. Among those at the head table were ASTM Past-President T. S. Fuller and the ASTM Pittsburgh District Officers: Henry A. Ball, chairman; C. H. Sawyer, vice-chairman; and A. L. Johnson, secretary. A. O. Anderson, chairman of the NAPA Standardization Committee for District 6, came from Cleveland and T. R. Zenk, national director of NAPA was also present.

In his illustrated talk, Mr. Painter stressed the importance of the widespread use of standards. American industry is devoting large sums and many man hours to research and standards work, but most benefits of this will come only as the standards are used, and use is definitely increasing. Purchasing agents are in a very effective position to stimulate even further use.

He stressed that standards do not stand still. They inhibit continuous change but at the same time provide for steady evolution. Workers in standards do not necessarily lead easy lives but they do have productive and useful ones.

Mr. Painter gave a series of case histories in which standards had been

extremely useful. In many cases dollar savings resulted. Examples were drawn from fields of heavy forgings in which ASTM did extremely effective work during World War II; the fields of bolts and nuts, cabinets, wood poles, etc. He laid considerable stress on the indirect savings—the simplifying of inventories, promoting of speed, improvement of production schedules, and simplification of office work.

The purchasing agents were reminded that where standards cannot be used, they are frequently a sound source of data on materials. The speaker cited an example where standards also embodied supplementary information on properties of materials which, although not binding in the requirements were indicative of properties that could be reasonably expected.

Challenging the purchasing agents to continue their interest in standards, Mr. Painter pointed out that there is no reason why the purchasing executive should not feel free at any time to submit constructive criticism of standards and specifications, and that it might be constructive if the viewpoint of the purchasing agent were considered more in the drafting of standards. The engineer and the purchasing agent must continue to cooperate even more closely.

The Pittsburgh District plans to continue its program of holding two or three meetings each year. One of the recent District developments is the decision to sponsor several student membership prize awards at leading engineering schools in the area, thus providing the student, the school, the Society, and the District with numerous mutual advantages.

NEW YORK

J. BURCH McMORRAN, Chief Engineer, Power Authority of the State of New York, spoke before almost 100 members of the ASTM New York District and the New York Chapter of the New York State Society of Professional Engineers at a joint meeting held in the Engineering Societies Building on May 26.

In his talk, "Engineering Aspects of the St. Lawrence Seaway and International Power Project," Mr. McMorran discussed the background of the Power Authority formed in 1931 under Governor Roosevelt, and concluded with the effect the seaway would have upon the industrial regions bordering the Great Lakes—particularly New York State.

Three Dams Planned

Present plans call for three dams to be built: one at Iroquois, Ontario, another near Long Sault Island for the

spillway, and the powerhouse dam at Barnhart Island. There will be thirty-two turbogenerators with a maximum capacity of about 1,880,000 kw shared equally on each side of the border.

The International Joint Commission will supervise the Canadian and American construction so that the project will not conflict with or restrain use of water for domestic, sanitary, or navigation uses and various other projects designed to safeguard all concerned to the greatest possible extent.

Iroquois Dam will consist of a buttressed gravity concrete structure with gate control sluiceway openings of sufficient size and number to regulate the highest flow under all conditions of lake elevations on Lake Ontario. Long Sault Dam will be a gravity dam with axis curved upstream. The spillway is of the overflow type controlled by vertical lift gates which will permit close regulation of the forebay water-surface elevation and discharge of any flows which are not passed through the turbines of the powerhouse.

The Barnhart Island power plant will generate all the power and will span the channel at the north end of Barnhart Island with one half of the structure in the United States and the other half in Canada. The concrete dam will be about 3200 ft long with the deck of the intake structure about 162 ft above the low point of the draft tubes and the maximum power head would be about 87 ft.

An extensive discussion period followed the talk. In replying to a question about competition from nuclear power plants, Mr. McMorran quoted a group of consultants who had studied this possibility, noting their conclusions as follows:

Nuclear power can be expected to begin competition with new steam plants in about ten years, competing in that year with the highest cost ten per cent of the new plants. The next ten years would be a period of further development. The competition of nuclear plants with new steam plants could be expected to increase so that at the end of 30 years the nuclear plants could compete with the highest-cost third or slightly more of the new steam plants to be built in the last year of that period.

It was on the basis of this report that the Power Authority was able to borrow 40 million dollars.

Mr. McMorran's talk was supplemented by a 30-min sound color film "Land of Promise" produced by the Cleveland Electric Illuminating Co.

A. A. Jones, Vice-Chairman of the ASTM New York District, conducted the meeting and Harold Carlson, ASTM program chairman, introduced the speaker.

Revised Federal Tests for Metals Reviewed by ASTM Committee Men

AT AN all-day meeting in the Pentagon on May 20, fourteen active ASTM committee officers and members reviewed with officials of the Ordnance Department the technical requirements of the voluminous proposed revised Federal Specifications for the Testing of Metals QQ-M-151a.

For many months intensive studies and discussions have been under way under the auspices of the Ordnance Department to bring up to date and expand this important Federal standard. Many other departments of the Government have been consulted and Technocopy, the New York firm of engineers who were retained to do the spade work, consulted many sources of information including the ASTM Staff. Many ASTM standards were of particular service and were considered in the study, including the ASTM Methods and Definitions for Mechanical Testing of Steel Products (A 370-54 T).

It was recognized that constructive comment could result if it were possible to have leaders in ASTM work involving the testing of metals review portions of the new Federal document. Accordingly a special panel was set up under the ASTM Ordnance Advisory Committee with the personnel listed below.

A great deal was accomplished at the six-hour meeting. In addition to their detailed individual review of the respective sections assigned, several of the men had reviewed other portions and in some cases the complete document was studied by their company associates, thus providing a wider evaluation.

A list of those comprising the panel follows:

Spectrochemical Analysis

J. R. Churchill, Aluminum Research Laboratories.

Chairman, Committee E-2 on Emission Spectroscopy.

Chemical Analysis

Arba Thomas, Armco Steel Corp.

Chairman, Committee E-3 on Chemical Analysis of Metals.

Clarence Zischkau, American Smelting and Refining Co.

Vice-Chairman, Committee E-3 and Chairman, Division on Non-Ferrous Metals.

Tension Test

C. H. Marshall, Baldwin-Lima-Hamilton Corp.

Secretary, Section on Tension Testing of Committee E-1 on Methods of Testing.

L. H. Winkler, Bethlehem Steel Co., Inc. Chairman, Subcommittee on Methods of Testing of Committee A-1 on Steel.

W. C. Clements, Bethlehem Steel Co.

Active committee member, serving as alternate.

Charpy Impact and Others

H. L. Fry, Bethlehem Steel Co., Inc.

Secretary, Committee A-1 on Steel.

Bend Tests

W. H. Mayo, United States Steel Corp.

Chairman, Task Group on Bend Testing of Committee E-1 on Methods of Testing.

Hardness Tests

R. H. Heyer, Armco Steel Corp.

Chairman, Identification Hardness Subcommittee of Committee E-1 on Methods of Testing.

Grain Size

R. E. Penrod, Bethlehem Steel Co., Inc.

Chairman, Section on Grain Size of Committee E-4 on Metallography.

Macroetch Test for Steel

E. A. Snader, Westinghouse Electric Corp.

Magnetic Test-Radiographic Test

Alexander Gobus, North American Phillips Co., Inc.

Chairman, Subcommittee on Standard Radiographs of Committee E-7 on Non-Destructive Testing.

Coating Tests

A. P. Jahn, Bell Telephone Labs., Inc.

Chairman, Committee A-5 on Corrosion of Iron and Steel.

O. B. Ellis, Armco Steel Corp., active committee member, serving as alternate.

Resistivity Test

P. H. Brace, Westinghouse Electric Corp.

Active committee member.

Hardenability Test

Salt Spray Test

C. O. Durbin, Chrysler Corp.

Chairman of the Subcommittee on Salt Spray Testing of Committee B-3.

Embrittlement Test

M. H. Brown, E. I. du Pont de Nemours and Co.

Member, Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.

Intergranular Corrosion Test for Aluminum Alloys

E. H. Dix, Jr., Aluminum Research Laboratories.

Member, Committee B-7 on Light Metals and Alloys, Cast and Wrought.

C. J. Walton, Mr. Dix's associate, serving as alternate.

Mercurous Nitrate Test

H. C. Ashley, Chase Brass and Copper Co., Inc.

Member, Committee B-5 on Copper and Copper Alloys, Cast and Wrought

Not only was the work of this group of outstanding service, but the fact that the extensive comments were developed in a relatively short time made the workmanlike job that was done the more commendable.

Technical Committee Notes

Structural Sandwich Constructions

Active Meeting Held at Forest Products Laboratory

TEST methods applicable in general to sandwich construction and test methods specifically aimed to determine core properties for use in design of sandwich were discussed at the April 27 and 28 meeting of Committee C-19 at the Forest Products Laboratory in Madison, Wis. A tour of the test facilities at the Laboratory demonstrated several test procedures of interest to the members.

There was also considerable discussion of the durability of sandwich constructions; various types of exposure panels are being planned for sandwich of types used in either aircraft or building construction.

Consideration was given to the preliminary planning of a symposium which the committee will sponsor at the Second Pacific Area National Meeting in Los Angeles in September, 1956.

At a dinner meeting members of the committee and their guests heard T. J. Martin, U. S. Department of the Air Force, discuss a non-destructive test method for sandwich construction. They also saw movies on the manufacture of plastic sandwich and the manufacturing techniques used in producing Glenn L. Martin's *Matador*.

Acoustical Materials

Lack of Data Presents Difficulty in Specification for Application Adhesives

THE development of a specification for adhesives used in the application of acoustical tile is proving to be a difficult problem because of the lack of basic information and tests by which the significant characteristics of the adhesive can be evaluated. A representative group of manufacturers of adhesives met to consider this matter preceding a recent meeting of Committee C-20 in Philadelphia on May 17 and 18. This specification is being prepared through a joint task group consisting of members of Committee D-14 on Adhesives and Committee C-20. The need for accelerated aging tests is recognized, involving plasticity, amount and

rate of cracking, linear shrinkage, and volumetric shrinkage. A short-term research project has been outlined and it is hoped to have recommendations before the October meeting of the committee. The Subcommittee on Application will also study the problems of mechanical suspension, considering the physical characteristics of the materials involved and determining what existing ASTM methods might apply.

The basic property of sound absorption continues to receive attention with very definite progress being reported in the direction of agreement on test procedures. The test method involving the use of reverberation chambers is probably the most extensive type of test procedure being developed and thus has required the greatest amount of research and background information. A final round-robin test is being made at Armour Research Foundation and the National Research Council of Canada. The results of these tests will provide important information on technique. A draft of a proposed method of test for impedance and absorption of acoustical materials by the tube method was given final review and has now been accepted for reference to letter ballot of the main committee. Two other test methods, namely, the box method and the horn coupler method are under study.

The establishment of a test method for measuring flame resistance continues to present problems. The current problem is that of establishing the use of a uniform fuel source containing the same Btu content in the gas. Several laboratories are in the process of using the modified method as prescribed in Federal Specification SS-A-118a, using the National Bureau of Standards procedure. A report was presented on the small scale tunnel test program at the Forest Products Laboratory, the latest test data indicating considerable difference in the results with the large scale tunnel test at the Underwriters' Laboratories. Additional tests with the small scale tunnel apparatus will include acoustical material. Other test procedures discussed were the radiant panel test and room burn-out test.

The problems of maintenance of acoustical tile are being studied through the consideration of tests to determine paintability and washability of the

materials. A draft of a washability test procedure has been circulated to the Subcommittee on Maintenance. The results of a study on soiling of acoustical tile, which is being conducted at the National Bureau of Standards by the Public Buildings Administration, will be available to the subcommittee for study when completed.

With the completion of tentative methods of test for strength properties of prefabricated architectural acoustical materials, attention is now being given to the use of Baumgartner Sphere apparatus for measuring light reflectance and to the study of air flow resistance.

Ceramic Whiteware and Similar Products

New Activity Developed in Titanates and Zirconates

ACTIVITY in the field of titanates and zirconates was inaugurated at the meeting of Committee C-21 held in Cincinnati on April 25 during the meeting of The American Ceramic Society. The section under the chairmanship of W. J. Baldwin, Titanium Alloy Manufacturing Division of National Lead Co., held a meeting on April 23, at which time plans were made for the development of test methods. At the same time the Section on Products met, and this very active group, under the chairmanship of W. C. Mohr, Shenango Pottery Co., reviewed nine proposed tentative methods which had already been submitted to letter ballot of the committee, six of which were included in the recommendations of the committee to the Society. In addition, proposed test methods for thermal conductivity of whiteware ceramics and for compressive or crushing strength of fired whiteware materials were given a final review before recommendation to the committee for letter ballot. A new proposed method of test for translucency of fired ceramic whiteware specimens was reviewed and further changes recommended.

The Subcommittee on Nomenclature, Prof. A. S. Watts, chairman, has continued its extensive activity in the consideration of additional definitions and terms to augment the existing list of over 60 which has been accepted and

published by the Society. Definitions of such basic terms as clay, whiteware, and ceramic, among others are now being processed.

The Subcommittee on Research, H. Z. Schofield, chairman, reported continued study of methods of testing properties of raw materials and ceramic whiteware products which are significant and as yet undeveloped. A group has completed a round-robin study on the measurement of sub-sieve particle size, the results of which will be turned over to the Subcommittee on Test Methods. New groups will be formed to investigate methods of determining modulus of rupture, the resistance of overglaze colors to detergents, degrees of vitrification, and brittleness.

Shipping Containers

Record Attendance at Forest Products Laboratory

COMMITTEE D-10 met on April 21 and 22 with the Forest Products Laboratory, Madison, Wis., as host to a most successful meeting.

Dr. J. H. Hall, Director of the Forest Products Laboratory, in his welcome to the committee praised its work as an example of the democratic way of getting things done. In reviewing current research progress, Dr. Hall stated that packaging technology has been enormously expanded with the development of many new materials and new approaches to cushioning problems.

The committee paid tribute to the late Thorwald A. Carlson, packaging research pioneer at the Forest Products Laboratory and a longtime committee member.

The four special Task Groups, appointed to review established test procedures to determine variations of results in duplicate tests, met concurrently to report on their respective collaborative testing programs.

The Drop Test Group reviewed a series of flat drop tests, using heavy and light containers which indicated an incomplete correlation of data. The conclusion drawn from these tests was that a higher degree of accuracy in the orientation of the container was required for making flat drop tests than that required for making corner drop tests. Several studies concerning the relative rigidity of steel plate embedded in concrete and a concrete slab on soil were reported. The Task Group recommended preparation of an explanatory table of different coefficients to show the effect of various drop surfaces and weights utilized for drop testing. The Task Group recommended that a revision of the Drop Test for Shipping Containers (D 775) be assembled for

review in the light of this extensive work.

The Vibration Task Group reported the results of having 100, 300, and 500-lb weights placed over the center of the deck, and over the rear or front axes during the tests. The test was arranged to be in two phases, one with weights secured to deck, the other with weights not secured to the deck. Difficulties in affixing weights prevented completion of the tests at this time.

The Revolving Drum Task Group reviewed a tabulation of variations of hazard location within revolving drums submitted by eleven owners. It appeared that the manufacturer might not be at fault in this connection due to the manner in which the blueprints are drawn. An engineer from a revolving drum manufacturer was consulted and his suggestion was that all hazards be located from the center line of the face. This suggestion will be incorporated in a revised series of drawings now in preparation.

The Stacking Task Group presented results of an extensive interlaboratory testing program. The results of this first program showed a wide variation of results and a revision of the test requirements was suggested for the next series of tests.

Activity in interior packing included the presentation to the Society of a new method of test for package cushioning materials. Other work in this field under consideration includes a proposed load deflection test, a series of definitions relating to cushioning terminology, and the appointment of several working groups to investigate other cushioning characteristics which may be of interest to the committee membership.

Adhesives

Panel Discussion on Problems of Tack

Much of the meeting of Committee D-14 held in New York City March 31-April 1 was given over to a panel discussion of the fundamentals of tack. Tack, or tackiness, was discussed as a complex quality of adhesives in which a bond may be formed by several chemical or physical characteristics exhibiting particular properties. The complexities of the theoretical and practical problems of tack were considered in the light of extensive experimentation by Messrs. Koehn, Rutzler, Perry, and Reynolds.

Other portions of the meeting were devoted to reviewing new work and progress on established programs. Two specifications for wood-to-wood adhesives setting at medium and high temperatures were presented for consideration. A proposed method of test of

solids content of urea resins has completed subcommittee ballot and is being presented to the committee for acceptance.

Work is actively being pursued on revisions of the Recommended Practice for Determining the Effect of Moisture and Temperature on Adhesive Bonds (D 1151), Methods of Test for Resistance of Adhesives for Wood to Cyclic Accelerated Service Conditions (D 1183), and the Method of Test for Effect of Mold Contamination on Permanence of Adhesive Preparations and Adhesive Bonds (D 1286).

Two new additions to the Tentative Method of Test for Consistency of Adhesives (D 1084) are being incorporated to include both the Brookfield and Stormer apparatus for measuring consistency. The committee has also recommended for approval as tentative the two methods describing the evaluation of the susceptibility of dry adhesive films to attack by laboratory rats and roaches, published as information only in June, 1954.

Wax Polishes

Two New Methods Readied for Hard Vegetable Waxes

COMMITTEE D-21 held its annual meeting in Chicago, Ill., on May 18, 1955. At this meeting two new tentative methods were accepted for presentation to the Society: the tentative method of test for the saponification number (empirical) of hard vegetable waxes; and the tentative method of test for the acid number (empirical) of hard vegetable waxes.

Continuing activities include work on temperature stability of waxes, adaptation application of methods of testing solvent type waxes to paste waxes, water spotting of emulsion type waxes, and evaluation of color and glass testing of applied waxes.

In an effort toward the further standardization of skid resistance of wax polishes, the committee is continuing work on a ground-glass plate to replace the tentative official test linoleum formerly used for this purpose. To insure a standardized skid resistance test machine, the committee intends to designate the Society as the repository for the machine blueprints, and the chemical specialties Manufacturers Assn. as the source for test charts for the James machine.

New areas of study include flash point of paste type waxes, analysis of silicones in polishes, chromatographic procedures for natural waxes other than Carnauba, and inclusion of automobile polish in the committee standardization program.

Mass Spectrometry

New Subcommittee on Solids Techniques Organized

The third Annual Meeting of Committee E-14 was held May 22 to 27, 1955, in the Mark Hopkins Hotel, San Francisco, Calif. An attendance of 300 gave evidence of the intense current interest in mass spectrometry.

Approximately 70 papers were presented during the meeting, seven of which were presented by authors from countries other than the United States. These included three from England, one from Germany, one from Holland, and two from Canada.

Of particular interest were the paper by H. Ewald who discussed a further refinement of the double-focusing mass spectrometer, and the discussion of European progress in mass spectrometry by J. Kistenmaker.

Evidence of American progress in development of a double focusing mass spectrometer was given in the paper by A. O. C. Nier of the University of Minnesota in which he discussed an instrument having a resolving power of over 20,000 which is now in operation at the University of Minnesota. Other papers provided a broad coverage of fundamentals, instrumentation, application, maintenance, techniques, interpretation, and calculation.

Increasing interest in the application of mass spectrometry to analysis of solids has resulted in the organization of a new subcommittee on solids techniques. Plans are now under way to organize a symposium on solids analysis by the mass spectrometer to be held at the next meeting of Committee E-14, which is tentatively scheduled for Cincinnati, Ohio, May 27 to June 1, 1956.

Committee on Electronics Materials Organized

A new committee on electronics materials was authorized in May by the Society's Directors to cover the field of materials for electron tubes and semiconductor devices.

Designated F-1 on Materials for Electron Tubes and Semiconductor Devices, the new committee will be concerned with materials such as grid wires, cathodes, mica stampings, glass-to-metal seals for electron tubes and luminescent materials used in cathode ray tubes and in fluorescent lighting. In view of its concern with many different materials, the new committee will be working closely with a number of other technical committees of the Society.

The officers of Committee F-1 are: S. A. Standing, *chairman*, Raytheon Manufacturing Co., Quincy, Mass.; F. J. Biondi, *vice-chairman*, Bell Telephone Labs., Murray Hill, N. J.; and S. Umbreit, *secretary*, RCA Victor Division, Radio Corp. of America, Harrison, N. J. Mr. Standing and Mr. Umbreit had been chairman and secretary respectively, of Committee B-4.

At its initial meeting in Atlantic City on June 27 and 28 during the Annual Meeting the committee adopted the following scope and subcommittee structure:

Scope.—The formulation of specifications and methods of testing materials used in the construction of electronic devices, as well as the stimulation of research and standardization of nomenclature. Electronic devices include tubes of all kinds, electric discharge devices and semiconductors.

Subcommittee Structure

- I. Cathodes
 - Analysis
 - Electrical Tests and Data
 - Mechanical and Physical Tests
- II. Insulators
 - Ceramics, Glass, Mica, Plastics

- III. Strip
- IV. Wire
- V. Metallic—Non-Metallic Seals
- VI. Semiconductors
- VII. Luminescent Materials

The new committee was created from a nucleus consisting of the former Subcommittee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps of Committee B-4 on Metals for Electrical Heating, Electrical Resistance, and Electrical Contacts, which had for some time carried out considerable research and developed a number of standards on materials for electron tubes. It was obvious that with the expanding use of these materials a new committee with a scope covering electronic materials was desirable.

Dean Harvey, Pittsburgh, will continue as honorary chairman of Committee B-4. E. I. Shobert II, Stackpole Carbon Co., St. Marys, Pa., formerly vice-chairman, will serve as acting chairman. Other officers will be: vice-chairman, Edward Edmunds, Driver-Harris Co., Harrison, N. J.; secretary, C. K. Strobel, Robertshaw-Fulton Controls Co., Irwin, Pa.; and assistant secretary C. L. Guettel, Driver-Harris Co., Harrison, N. J.

The "F" series of committees represents a sixth series of ASTM technical committees beside the well-established groups on Ferrous Metals ("A" series), Non-Ferrous Metals ("B" series), Ceramic and Masonry ("C" series), Miscellaneous Materials ("D" series), and Miscellaneous Subjects ("E" series). They will be concerned with all types of materials for specific purposes and their scopes will be based on use and function rather than on specific materials. It may well be that some of the existing committees which are organized along the same lines may be redesignated and placed in this same series.

To ASTM Nonmembers: The Society welcomes inquiries on the "Advantages of Membership"

To the ASTM Committee on Membership
1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on Membership in ASTM and include a membership application blank.

Signed _____

Address _____

Date _____

Random Samples...

FROM THE CURRENT MATERIALS NEWS

From the broad stream of current materials information flowing from "in-box" to "out-box" in a busy editorial office, random samples (mostly random) have been plucked. Thinking them worth re-showing to ASTM'ers who may have missed the original articles, we have included them here. Of course, we had to trim the samples to fit. There will be those who are not satisfied with samples, especially ones which are not really random. But these ASTM'ers can contact the institution, magazine, governmental agency, etc., who placed the original information in the stream, or address Random Samples, ASTM, 1916 Race St., Philadelphia 3, Pa.

Memories, Memories

REMEMBER the story about the memory of an elephant? This has been outdated as completely as Grandpop's Model T. The International Telemeter Corp., 2000 Stoner Ave., W. Los Angeles, Calif., recently delivered what is believed to be the world's largest memory to the Rand Corp., 1700 Main St., Santa Monica, Calif.

The brain of the "Mnemotron" consists of 170,000 magnetized rings or cores made of a ceramic material called ferrite. A mixture of iron ore, magnesium, and manganese oxides is baked to form the individual ferrite cores. This material can be magnetized instantaneously, and once magnetized, it remains in this state indefinitely.

Reading information from the memory consists, essentially, in determining the direction of magnetization of the ferrite core being examined at the moment. Three wires run through each core. A current is passed through two of these wires. If the core is magnetized in one direction, there will be only a slight change in its magnetic state. If it is magnetized in the opposite direction, the effect of the current will be to demagnetize it completely and then reverse the direction of magnetization. When this happens, the core will induce a current in the third winding, called the reading winding.

The absence or presence of this current in the reading winding, therefore is an indication of the direction of magnetization (zero or one state). Zero and one are used simply because it is convenient to talk in terms of these numbers. One direction of magnetization could be called a dot, and the opposite a dash. And for certain uses, there is nothing to prevent saying a ring storing a dot followed by a ring storing a dash represents an A, as in the Morse Code. If there were enough of these rings and if there was some way of instantaneously recognizing the direction of magnetization of each ring, a large amount of information could be remembered in this way.

To determine which of the 170,000 cores are reading zero or one at any instant, two of the windings pass through each core at right angles to one another. Each of these windings carries one-half the current necessary to produce an output from the core. The only core which will get enough current for an output is the core at the junction of two lines, both of which are being picked. If these lines are regarded as streets going in one direction, and avenues going at right angles to the streets, a given core has to be on the right street and on the right avenue in order to get the two one-half currents necessary for the reading.

In the Telemeter Mnemotron, the streets are referred to as X lines and the avenues as Y lines. On each matrix there are 32 X lines and 128 Y lines. Therefore, there are a total of 4096 cores in each matrix, one core at each juncture of an X and Y line. There are also four extra Y lines which can be switched into the circuit in case of damage to any one of the cores.

In the Mnemotron there are 40 such matrices. A complete word consists of the information stored in every core in the same location on each of the 40 matrices. For example: If the first bit of information is stored in a core located at the juncture of the third X line and the fourth Y line on the first matrix, the second bit of the word will be stored on the third X line and the fourth Y line on the second matrix, etc. All 40 bits in the word are read or written simultaneously.

It was mentioned before that each core is capable of storing only a zero or a one. Actually, when you get right down to it, all each core can do is be magnetized one way or the opposite way—just like the compass needle. Computer engineers think of such devices as the simplest possible containers of the most basic unit of information. They call this unit of information a *bit*.

All that the word bit means is one or zero (or yes or no). Any other information can be measured in terms of a

certain number of bits (or of *yesses* or *no's*). In the game of Twenty Questions, the person playing the game has 20 bits available to him. That is, he can ask 20 questions and get answers of yes or no each time.

Actually, with 20 bits, he is mathematically able to pick one item out of a million. Six bits are sufficient to communicate all the characters which would ever be necessary in printing a book. Since the average English word is about five letters in length, 30 bits would be sufficient to communicate the average English word. In the RAND memory, because of the needs of the computer, a word is 40 bits in length.

The term "word" is used here not in the usual sense, but simply to define a certain number of bits that go together as a group. With 40 bits, the largest decimal number possible is a million-million.

Vapor-Free Vacuums

CLEARING the path for electrons in "atom-smashers" and radar power tubes is the role of a new, completely dry, high-vacuum pump soon to be released for sale by Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y., a subsidiary of Consolidated Engineering Corp., Pasadena, Calif.

Called the EVAPOR-ION pump, the new device combines a titanium evaporation process and ion pumping to produce low pressures (less than 10^{-8} mm Hg) without using refrigerated traps or baffles. The revolutionary pump, invented by Professor Ray Herb of the University of Wisconsin's Physics Department, is expected to render obsolete a number of present high-vacuum pumping techniques.

The EVAPOR-ION pump is believed to be the first major new development in high-vacuum pumping technology since the development of the self-purifying oil diffusion pump in 1936. It will provide American industry with a new way to produce high vacuum,

which is fast becoming a basic process tool in many industries.

Developed to produce a vapor-free vacuum for the large high-voltage particle accelerators used in "atom-smashing," the pump is expected to play a vital part in future nuclear research programs. Other potential applications for the EVAPOR-ION pump include the evacuation of electron power tubes, color TV tubes, large X-ray tubes, and mass spectrometers.

High-Temperature Testing of Metals Goes Electric

TESTING of "super alloys" for high-temperature service went all-electric recently in the new laboratory of Universal-Cyclops Steel Corp., Bridgeville, Pa. Electrically powered and designed for electrical measurement of both applied tensional loads and resulting specimen strain, one of the first testing machines based on SR-4 bonded resistance wire strain gage devices is being used here for tension tests at temperatures up to 2200 F.

An unusual feature of the tests is the use of a simple but ingenious temporary substitute for the Baldwin SRD-1 deflectometer for the measurement of the extension or strain of 0.160-in. diameter, 1-in. gage length buttonhead specimens while being held at testing temperature within electric furnaces. This device is an SR-4 extensometer held by a clamp on the platen of the machine. An extension of about $\frac{1}{2}$ in. can be measured as the platen lowers to stretch the specimen. This lowering unsprings the upper extensometer arm which is in contact with the vertical rod fastened to the stationary crosshead of the testing machine.

The strains that are sensed in this way are transmitted electrically to the recorder to control strip-chart drum rotation by proportionate amounts. Strain magnifications up to $250\times$ can be obtained in this way. A measuring range up to 5 in. and magnifications up to $10\times$ are provided by the deflectometer which will be used in the same position.

An important factor in these high-temperature tests is close control of strain rate, which Baldwin-Lima-Hamilton Corp. provides by regulation of a motor drive loading control. Testing speeds can be varied from 0.025 to 9 in. per min.

Loads up to 50,000 lb in tension or compression are sensed by SR-4 load cells at the bases of the two columns. Both the load indicating pointer and the recorder pen movement are controlled by these cells.

Frequency of tests at elevated temperatures in this new machine was multiplied by use of specially designed rotary jig. This jig carries eight electric furnaces in which test specimens can be heated simultaneously under independent automatic controls. Each furnace can be swung into testing position while temperature control is maintained.

Tension-compression cycling tests, a new feature in universal testing machines of this type, may be carried out at various temperatures using any two loads between 50,000 lb compression and 50,000 lb tension.

Something to Crow About

A CONTROLLING factor in the rate of production of sheet metal parts is the speed at which the operator can disengage the oiled sheets from one another and pass them through a slitter—without risk of double feeding and without undue fatigue. The Buckeye Insulator Co., Springfield, Ohio, seems to have hatched something worth crowing about. Casting about for a key to this situation, the sheet fanner magnets, newly developed by the Eriez Mfg. Co., Erie, Pa., were discovered.

The peculiar attribute of these little (6 by 12 in. high) gadgets is their ability to induce like charges of polarity in strips or sheets of steel, causing individual pieces in a pile to be so strongly repelled by one another that the upper pieces in the pile rise an appreciable distance in the air and remain suspended. When the top piece is removed, Buckeye Insulator claims, others below it immediately rise to higher positions. The sheet fanner itself has no moving parts; it consists of a nonelectric permanent unit of Alnico metal which is guaranteed to radiate its potent, invisible, magnetic field indefinitely with no diminution in strength. The wholly enclosed unit is installed by simply bolting it to the table, adjacent to the stock. Maintenance is nil.

Aluminum Flies On

RESEARCH is lifting the thermal barrier that has threatened the use of aluminum in supersonic aircraft of the future. In raising the veil on its new patented high-temperature aluminum alloy called X2219 the Aluminum Company of America stated that other pending alloy developments will combine with the current one to effectively raise existing temperature limits on aluminum.

Use of aluminum in supersonic aircraft was jeopardized by elevated temperatures of high-speed flight. Friction

with air at speeds over 1000 mph generated intense heat in the skin of an airplane. This heat, combined with that generated by the engine, threatened to raise the temperature in some parts beyond the efficient performance level of existing aluminum alloys.

Faced with this problem, Alcoa's Aluminum Research Laboratories were assigned the task of adapting aluminum to high-temperature conditions. The first result is Alcoa alloy X2219, available presently in experimental quantities, which Alcoa claims offers excellent properties at 500 to 600 F. This temperature range is valuable for applications in and near aircraft and automotive engines.

Alcoa's research laboratories expect alloy developments in the near future which will allow excellent properties in the 300 to 400 F temperature range. This range is valuable for structural use in supersonic aircraft.

Powdered Nylon—A New Engineering Material

PARTS formed by cold pressing and oil sintering nylon powders have been found to possess an unusually low coefficient of friction in a wide range of industrial applications, such as gears, bearings, rollers, and similar parts subjected to light loads. Though providing these improved characteristics, sintering nylon costs no more than molding it, and mass production is both economical and practical.

Tests conducted by National Polymer Products, Inc., Reading, Pa., indicate two especially important fields for sintered nylon—low torque applications and intermittently operating parts. In such cases, standard molded nylon never has a chance to break in to its ultimate low coefficient of friction, whereas parts from certain sintered nylon formulations, National Polymer states, provide constantly low friction from the very start of operation.

The unusually low coefficient of friction in sintered nylon is obtained by the addition of various inert filler materials and also by the penetration of oil from the sintering bath into the pores of the part. Filler additions are also reported to give finished nylon parts greater dimensional stability as well. These properties are most significant where close tolerance parts are to be mass produced.

Fillers of various kinds give different characteristics to nylons. When the plastic melts, as during the forming of injection molded parts, the fillers do not remain suspended. Only by the process of cold pressing and sintering can the fillers be added without segregation.

ACR Notes

Administrative Committee on Research

Random Thoughts

By Bruce W. Gonser

THERE used to be a saying among research men that about half the job was in finding out just what the problem was. Certainly the value of defining a need clearly and outlining a plan of attack should never be discounted. Like writing a technical paper, the job is half done when the first paragraph is finally written. That is one reason why the Administrative Committee on Research has given so much attention to finding, defining, and publicizing problems whose solutions would be helpful to the work of ASTM.

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To stir up more interest in researches that affect the activities of the Society—and it is amazing how far-flung these activities are—the committee has been contemplating the organization of a series of symposiums on current research work. A symposium on research could prove to be one of the most useful and inspiring activities of the Society.

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The editor of the BULLETIN and his assistants certainly have a problem in dealing with activities of ASTM Committees A-1 to F-something, and with members having interests from soap to nuts—and bolts. Some of these activities, described by specification-minded members, make rather dull reading. Surprisingly, though, some of the work and results of tests recently completed are of wide interest. A real job, then, is to get such items written into a concise, nonponderous form that will be more palatable to the average reader.

Since one of its most important aims is to aid in spreading the good news of the Society's progress in obtaining new information on engineering materials, the ACR has been considering this problem. It is a most worthy hope—to add sufficient zest to the presentation of research results that people will read them and profit by them even though primarily interested in other fields. So far, no definite plan has been formulated. It's easier to figure out what to do than to find the men to do it.

¹ Battelle Memorial Inst.; Chairman ASTM Administrative Committee on Research.

One of the most pleasant tasks of the ACR is to maintain liaison with research groups in other organizations. Chief among these is the Division of Engineering and Industrial Research of the National Research Council. Like ASTM, the breadth in coverage of activities by this Council is amazing.

There are some tests in progress by the Highway Research Board on highway construction for modern heavy truck traffic that is of direct interest to nearly everyone. Planning the practical tests that show definitely the effect of different loads on pavements of varied composition and thickness has been an undertaking to evoke the admiration of any engineer. Moreover, results are being obtained that not only point to better highway construction, but also can serve as a basis for equitable taxation and regulation of the vehicles using the highway.

The National Research Council's research on cargo handling covers another type of transportation where factual information has been lacking. An analysis has been made of the time, labor, and costs involved in the various steps of moving goods to the shipping point, storage while awaiting the cargo boat, loading, the voyage, unloading, storage at the point of cargo discharge, and transportation to the final point of delivery. Here again, much of the problem is finding out how to define it and where the greatest improvement can be made. Unitized or standard-sized packaging units for greater speed in handling may be at least a partial answer to this problem. It is interesting to note that an Icelandic air line has been successfully using unitized aluminum containers that fit the contour of the plane cargo space to simplify their handling problem.

Another example of the National Research Council's many interesting activities has been artificial-limbs research. There is not much chance for standardization here, but there has been a wonderful opportunity, well handled, for using sound engineering in devising improved equipment for artificial limbs. As in so many researches, much time had to be taken for men with medical training to learn enough of engineering materials and methods to give their

analysis of what might be done. Likewise, those with engineering training had to learn a lot about physiology and nature's joints to be able to get on common ground with the physicians. This cooperation has had a most useful, happy ending, although, as always, there is still room for getting even better results.

• • •

In this approaching atomic age, materials of construction for reactors, shielding against radiation, and all sorts on new problems are being presented in utilizing most efficiently and safely the power giant that is evolving. Aside from the usual engineering requirements of many materials, the effect of radiation of enhancing or diminishing desirable properties is a question that needs answering. This partly accounts for the recent rash of radiation laboratories or reactors now under construction. It is a rather involved subject—too long to handle concisely on a hot day. Rather, one's thoughts turn to swimming, and how much better some swimming-pool reactors could be utilized for comfort in place of the very scientific purposes for which they were built.

This brings up an example of one of the chief requirements of a good research man—a lively curiosity, and the will to do something about it. Looking at the swimming-pool-type reactor when both he and it were not too busy one day, a research worker wondered how a gold fish would fare in that sinister environment. By reasonably legitimate means, a gold fish was secured and dropped in with a little food as a going-away present. Surprisingly, it lingered only briefly at the top out of harm's way, but swam to the very bottom where there was nothing to graze upon but cobalt isotopes. Moreover it stayed there for two weeks, apparently enjoying the surroundings, before passing out and up, permanently. In the post mortem, there were some who thought the gold fish went down to get his gold transmuted to lead. However, being more intelligent than shown by his facial expression, it is probable that the fish merely followed the trail that led to the greatest concentration of oxygen in the water.

What Is It?

Annual Address by the President, June 28, 1955

Norman L. Mochel¹

In recent years, I am sure that you have noted a tendency on the part of our retiring President to let the report of the Board of Directors speak for the activities and well-being of the Society, and to use the time allotted to him to deal with a subject that seemingly impressed him, beyond the ordinary, during the year.

Two years ago Dr. Maxwell spoke of "People and Things," of the manner in which we pay tribute to the dignity and well-being of people, and to the usefulness of things. People, he reminded us, are infinitely more important than things.

And last year, at that very colorful luncheon meeting at Chicago, Dr. Beard spoke of "Plain Talk." He desired to discuss what he called an unhealthy trend in science—the breaking down of communications between the various sciences and the public. He spoke for the opportunity of better identification and understanding of people and things, through the medium of plain talking.

The now retiring President would follow this trend of recent years. Indeed, he sincerely hopes that his remarks of the hour may well fit, as it were, in a series with those of Dr. Maxwell and Dr. Beard, since he, too, is interested in people and things, and for better communications—and better identifications.

Better Identification

At this point, I am reminded of that incident in William Shakespeare's great comedy *As You Like It*, where the rather likable Jaques, in exile in the forest with the deposed Duke, has an encounter with Touchstone, the jester. Upon meeting with the Duke later at dinner, he tells the assembled company:

"A fool, a fool! I met a fool i' the forest,
A motley fool;"

and after describing the encounter in some detail, he ended with:

"O that I were a fool!
I am ambitious for a motley coat."

Upon being told by the Duke that he might have one, Jaques then reminded his friends that:

"I must have liberty
Withal, as large a charter as the wind,

¹ Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia, Pa.



N. L. Mochel

To blow on whom I please; for so fools have;
And they that are most galled with my folly,
They most must laugh."

During this past year, and especially in one instance, and purely because I was your President, and because of our deeds or lack of deeds as a Society, I was subjected to what I may honestly call severe criticism and pressure. You will all recall, from the rather wide newspaper coverage, of a serious mishap that occurred during the dock trials of our first atomic-powered submarine, the *Nautilus*, in that a steam pipe burst under pressure, with injury to operating personnel, and serious delay in putting the *Nautilus* to sea. It developed, as all who read must know, that the failed pipe was not of proper grade. The piping had been ordered to an ASTM specification, and immediately the specification, the several revisions that had been made to it, and the entire question of marking and ready identification was a fit subject for critical examination.

During the Western trip in February and March of the President and the Executive Secretary, they were at dinner with a group of ASTM members and their wives, at a place that shall be

nameless, in San Francisco. To keep us busy while the food was being prepared, the long table was generously provided with platters of two articles of food. It was obvious that the well-browned and tasty bones that were given us to gnaw upon are usually referred to as spare-ribs. The other article was a triangular-shaped pastry of some sort. Soon the question developed at my end of the table as to what it was. Having known from my boyhood days something of the manner in which pie and pastry makers mark their product, I carefully looked for an "S" for "snake" or "shark," or an "O" for "octopus," or the like, but there were none such marks. On opposite sides of the table were two chemical engineers of wide experience. Each took a piece of the questionable article. Said one to the other, "Let us, two chemists of world-wide reputation, taste and see if we cannot tell what it is..." But after tasting, both shook their heads and both were heard to say "What is it?"

Of course, the point in this little incident, aside from giving me my title, is that maybe it is well that some things are not and cannot be too well identified.

The pastry also leads me to the point that from our very earliest childhood, we

are taught to identify things and ourselves.

"Patty cake, patty cake, baker's man,
Bake me a cake, as fast as you can,
Pat it, and roll it, and mark it with 'T,'
And put it in the oven for Tommy and me."

Possession or potential possession has long been a basis for marking. One of our very early markings for identification was a symbol of the British Crown, in the form of a broad arrow, which marked the larger pine trees in New Hampshire and Maine that were set aside for the Crown, to be used as masts on sailing ships. Way back in the valleys, every once in a while they run across one of these markings even today.

The identification of people down through the ages, even to now, is an interesting subject. From the very beginning, when we are told that God put a mark on Cain, the military, church state, society, and industry have, for various reasons, identified people by dress, badge, symbol, hair, and even by branding.

Look around this room. We are all sedately identified. Why? Much of it is lost—but it is important to us that the 1 or 5 or 10 or 50 or even 99 per cent who do not know us—may see who we are.

Many of you belong to those organizations where upon entering the room you go to a rack and get your large round badge, with perhaps RED in great big letters and Smith in small letters, or SLIM in great big letters and Brown in small letters; otherwise no one would know that you treasure the memory that once the hair was of Titian-blond, or the figure less robust.

Now identification of both people and things becomes more important and there is greater responsibility, as our knowledge of people and things grows. I have in my hand one of the "dog-tags" that I wore on a greasy tape around my neck in World War I. Just my name, and USA, and my serial number. I also hold one more recently worn by my younger son. The name, the USA, the serial number are there. But now there is the date of the tetanus shots, the type of blood, and down in the corner, a P, a C, or a J, to show his religion. It is important that these things be there with the person, for immediate use, rather than to be recorded only on the man's service record which may be miles away, or not at all. And this is true for materials at times.

Identification markings or methods will vary in many ways, depending upon the nature of the person or thing. To identify or not to identify is the first question. It is easy to identify some

things; it is very difficult to identify others. But the difficulty of doing it must not be accepted as the reason for not doing it. The matter of cost will also vary and here comes in a matter of values. Indeed it would appear that in some cases, where necessity hardly applies, great lengths are gone to in identification; but in others, where property loss and very life are involved, we worry as to costs and difficulties.

Permanence—A Problem

Permanence of identification is often a problem. The purpose has a time value. The identification of a can of tomatoes is of little use after the can is opened and the contents consumed. When specification changes are made that are of any moment, changed identifications must be employed. Yes there are problems, even here. I am sure you all heard of the big American sailor who returned to the tattoo artist to see if the name Gwendolyn on a hairy chest could not in some way be changed to Mary.

Must Be Real

Identification must be real, truthful, not fictitious. I recall many years ago being in the shipping room of a steel mill—now closed down, so the tale may be told. To my utter amazement I saw stacks of tool steel labels, of two if not three other branch plants located in other parts of the country, and of Standard, Choice, and Special grades, all being pasted on bars from the same racks, to suit various orders. And to my question, you will be amazed at the answer: "We give him the color label and the name that he wants." That day I trust is gone forever.

Identification, just as Dr. Beard said about talk, must communicate properly. A story will illustrate, I am sure.

A customer in a Montreal restaurant went to the washroom, turned on a cold tap and just escaped being badly scalded.

"This is an outrage!" he screamed at the manager. "Why aren't your taps marked properly?"

The manager led the injured diner back to the washroom. "Look," he said patiently. "The tap is marked 'C' correctly. That stands for 'chaude,' and in French 'chaude' means 'hot!' You should know that if you live in Montreal."

The customer stood abashed for a moment. Then he made a discovery. "But look again," he cried. "The other tap is marked with a 'C' also! What about that?"

"Ah," said the proprietor, "that stands for 'cold.' This is a bilingual restaurant, my friend."

Examples—Military; Fibers; Pressure Vessels; Metal Products; Drugs

The identification of pipe lines and compressed gas cylinders has long been an important matter. There have been serious disfigurements and even deaths from errors from poor identification of both. Military Standard 101A was issued last year. An excellently stated Foreword to the specification ends in this manner: "While this standard was prepared for use by the Military Establishments, it is the hope that industry as a whole will eventually adopt this color code." I recently called to the attention of the operating head of a new and large engineering laboratory that there was such a specification and, knowing that he would have a growing problem of identification of both piping and gas cylinders, suggested that he consider its adoption. Upon being told that his piping problem was too complicated, if anything, the very reason for the adoption of the specification, I must confess I gave up.

One reads with much interest of the many synthetic fibers on the market or ready to go on the market, or still in the pilot plant or test tube stage. One appreciates the tremendous testing program under way today, as you and I carry out this program by buying and wearing the product application of these fibers. Take a good look, the textile experts say, at the label on any new blended fabric and make sure it states the exact percentages of each fiber. They say that this will not mean much to you; to this I would disagree in part, since you and I will report the actual results in the old law of demand, but they point out a responsible manufacturer will not hesitate to say just what his material contains.

I have already made reference to the Military Specification for identifying pipe lines and gas cylinders. Work is progressing along military and national lines and in other fields as well. For example, a specification covering the identification of iron and steel products in general has had wide attention. As another example, one dealing with the Nylon Cord Manufacturers Color Code Identification is worthy of reference in the aviation field. I think we are all familiar with excellent identification practices on the part of the fire underwriters, on electrical parts and on boilers and heat exchangers. The identification system devised by the National Electrical Manufacturers Assn. for welding electrodes is an important matter, worthy of note. And even such things as chocolate candy have identification practices.

Private companies have effected identification systems based on colors for

their product. It is noted that the Aluminum Company of America has a color system for distributors' stocks of aluminum and its alloys. Other nationwide distributors of metal products have color standards. And nearly every consuming interest has an internal color standard. But the same color means something widely different from place to place, and this means trouble some place, sometime, for someone.

I hold in my hand a metal container, full of white pills, of a well-known article, which after these rambling words, I may have to use this afternoon. If I lose these particular pills from this container, I shall still know what they are, for each pill is double marked. It gives me confidence. I have a good friend who operates a very high-grade apothecary establishment. I was interested to know how far the manufacturers of drugs had gone in identification on the pills as well as on the package. By printing, forming, indenting, speckling, full and partial colors, as well as size and shape, I found tremendous strides are being made in this field of which I know very little. Yet, I picked up, just for example, eight different white pills about the size of those in my container. They are entirely different. They range from common sodium bicarbonate to several rather potent drugs. I mix them, and I am lost. The containers are very pretty, I shall save them. The eight white pills must go down the drain.

Pipe and Its Problem

Now it's a far cry from pills to pipe. They have common letters *p* and *i*—they're usually round. But here the similarity ends. Yet we have a similar problem. Here are three pieces of steel pipe, all of the same diameter and wall thickness. One is butt-welded pipe for very ordinary services; the second is of seamless carbon steel for higher grade services; the third an alloy steel for high-pressure service at red heat. At this stage, they have lost their identity. Some here who are experts might pick out the poorest grade. Most of you could not. Misapplication may bring death, injury, and loss of property. And yet we allow the identification of smaller sizes of these pipes—and do not even define what are "smaller sizes"—by tying in a bundle and tying a metal tag to the bundle. And the statement has been made that it is just a matter of good housekeeping to keep these various

grades of pipe properly identified and safely applied at all times. And here's a piece of stainless steel tubing for use at higher temperatures and pressures. A little bit of alloy addition allows its use at far higher stresses at these red heats than similar steel without the additional alloy. And with no marking provided and absolutely no difference in appearance, we expect good housekeeping to keep us safe from harm. I am told that a marine boiler recently taken from a ship contained everything from plain carbon steel to 4 per cent chromium steel, mixed "willy-nilly" throughout. Good housekeeping! I wonder how the ladies would feel in our large grocery stores that keep getting larger and larger, if all the canned goods were identified only by the crates they came in. Even this is better than the tied bundles of pipe. And imagine our shelves in the stores filled with bare cans, and you ladies were dependent only on good housekeeping at the stores, and in your own storage, as to whether the can contained corn or peaches, or what not. I'm sure you ladies just would not put up with such a situation and would demand better identification.

ASTM Standards—More Marking?

I have made no attempt to read all of the specifications in our seven volumes of standards. But I did make spot checks in all fields, and I am convinced that, as a Society creating specifications for engineering materials, we have left much undone in our work. In many cases, we require only that the name of the manufacturer shall appear. So often we do not require marking to show that the material meets our own ASTM specification, and that's not very good advertising! I watched the unloading of a truck load of bags of cement the other day. Some bags were prominently marked as meeting such and such grade of an ASTM specification. But a large part of the lot was not marked. Was this a grade too poor to be marked? I looked into it and found that we do not require that the lowest grade in the specifications be marked. Advertising is a good way to communicate to the public. I look at every load of ready-mixed concrete that passes me on the street, and the day I see one with a large sign on it that the product in this truck meets an ASTM specification, I'll doff my hat and say "Well done," or "Amen."

Everywhere I go, I see products that *were made or should have been made* to ASTM specifications. And there are many important applications where it appears to me that identification to the specifications should be there for *all* to see. In my opinion, we have done well in our identification requirements in many; we have done average in many; we have done poorly in others. It's a little like my friend Touchstone, the jester of *As You Like It*, who said when he received the answer "So so" to a question. His remark was:

"So so is good, very good, very excellent good;
And yet it is not, it is just so so."

And I think we should stop being just "So so."

And then there are new fields ahead. We have a new subcommittee on hydraulic lubricants. Recently several of us were visiting at a plant where a turbine was operating on a synthetic lubricant. One of our number innocently did what any engineer would do—stuck his hand in an exposed-flow to "feel" the oil. Quickly, without a word he was unceremoniously rushed to a washroom and washed free of the liquid. Whether the matter was real or for effect, I do not know. Another friend instinctively picked up a mechanical part that had been in service where nuclear products were involved. He was rushed to a decontamination center forthwith. These are merely referred to as evidence of the more complex things ahead.

It follows that as life becomes more complicated, as the atomic age comes in, and more dangers are present, if we are to really believe as Dr. Maxwell said that people are infinitely more important than things, then for self protection people will have to pay more attention to this matter of identification.

In conclusion, I ask myself and you three questions:

1 Will we take this matter seriously and solve those problems before us?

2 Or will we wait until the public takes it in hand and by legislation takes over.

3 Must we perfect and further develop test apparatus and methods that will permit checking of materials in final place—before actual operation?

I close with a suggested slogan:
"He who creates shall identify."

SUGGESTED SLOGAN

"He who creates shall identify"

A Test for High-Power D-C Arc Resistance of Electrical Insulating Materials

By Marvin M. Fromm

THE ARC resistance of solid insulating materials is a property of great importance in many industrial applications. In the past, there has been a great deal of discussion about the many test methods which have been devised to measure this property. Out of this discussion has appeared a growing realization of the inadequacy of some of the present test methods and of the need for clearer thinking on the subject.

Part of this confusion may be due to linking together "track resistance" and "arc resistance" which should be recognized as distinct properties. Track resistance is defined as the ability of an insulating material to resist the formation of conducting paths under the continued application of an electrical stress. This condition exists in high voltage bushings, electron tube sockets, and many types of structures used to support bare conductors. Arc resistance, on the other hand, refers to the ability of insulating materials to resist the formation of a conducting path when subjected to electrical arcs across their surface. This condition occurs in generators and motors used on railway traction equipment, and many types of switching apparatus.

On the basis of these definitions, existing test methods may be classified for measurement of arc resistance or of track resistance. Since both of these properties relate to the performance of a given material in service, the test methods used should duplicate the essential characteristics of the application.

At the present time, the only standardized test for arc resistance is ASTM Method D 495 - 48 T.¹ This test rates the arc resistance as the number of seconds before failure under a surface arc of low energy, between pointed metal electrodes. Recently, there has been growing recognition that the results of this test are not entirely satisfactory, since they do not correlate with

experience in service when materials are exposed to electrical arcs of higher energy content. In one case, the use of the ASTM arc resistance as a design criterion led to failures in service under high-power arcs and flashovers.

It does not appear reasonable to expect that one test for arc resistance will serve for the many different conditions met in service. Experience indicates that, in addition to chemical composition, the arcing performance of insulating materials depends greatly on the power expended in the arc. There seems to be, therefore, a need for a test which rates behavior of materials under high energy arcs. Such a test must (1) correlate with performance in service; (2) be reproducible; and (3) express the results by some numerical rating or rank. Preferable, but not essential, is a test which is easy to perform, does not require elaborate equipment, and can test materials in a readily available form.

A test meeting the essential require-

ments has been developed and used successfully. Specimens of insulating material, in sheet or tube form, are subjected to arcs of 500 amp dc, between graphite electrodes. The test area is then checked with 500 v dc to see if it

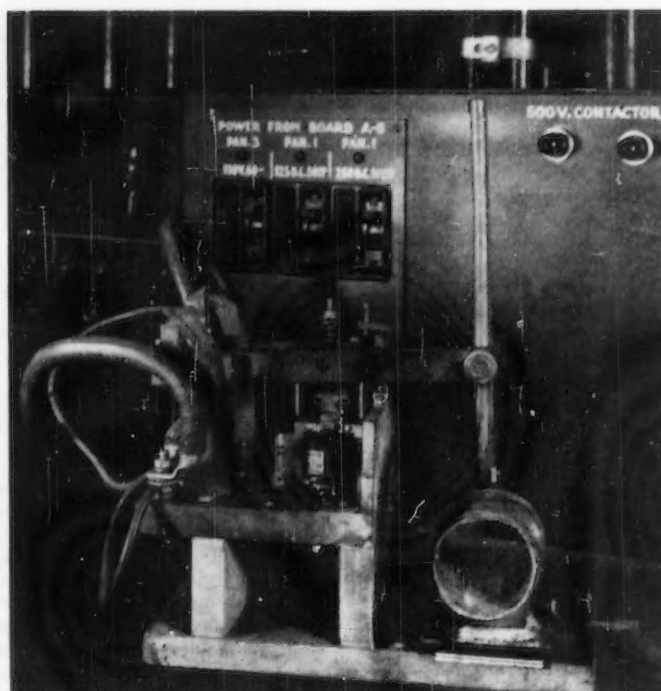


Fig. 1.—Close-up View of Tester.



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¹ Tentative Method of Test for High-Voltage, Low-Current Arc Resistance of Solid Electrical Insulating Materials, 1952 Book of ASTM Standards, Part 6, p. 1136.

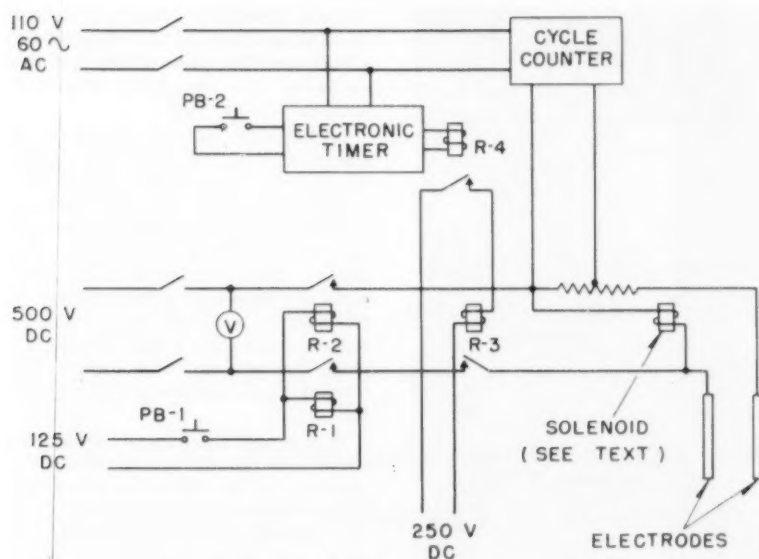


Fig. 2.—Circuit for High-Power Arc Testing Table.

has become conducting. Successive arcs are applied until conduction occurs, or for an arbitrary number of shots.

Description of Tester and Circuit

On the test bench constructed to facilitate operation of this equipment are mounted a cycle counter, adjustable electronic timers, switches for power circuits, operating push-buttons and pilot lights, and the arc test unit. A closeup view of the tester is given in Fig. 1.

The tester consists of asbestos lumber structural members on which the operating parts are mounted. Two horizontal brass bars, insulated from each other, serve to carry the current to graphite electrodes. The bars are mounted on the armature structure of a solenoid contactor coil. Energizing the coil forces the electrodes down against the specimen surface, while a spring pulls the arm and electrodes up away from the surface when the coil is de-energized. Flexible copper leads carry current into the brass bars.

The operating circuit for this tester is shown in Fig. 2. The power electrodes are connected to a 500-v dc source through a 1-ohm resistor, and the solenoid coil is designed for operation at this voltage. Power contactors, R-1 and R-2, are energized by pushing and holding down PB-1. When PB-2 is pressed and held down, the electronic timer starts, closes control contactor R-3, energizing the solenoid coil, and closing the power circuit. When the period set on the electronic timer ends, the coil is de-energized, but by continuing to hold down PB-1 and PB-2

the solenoid coil is re-energized every 2 sec, applying 500 v dc to the test area. Some features of this circuit are designed around the available 500-v dc shop power supply, which consists of two 250-v motor-generator sets, series connected with grounded neutral. For example, two pilot lights indicate that both machines are in operation.

Test Procedure

The specimen is placed under the electrodes; if a tubular specimen is used it

is placed on a wooden block support to keep it from turning. A No. 24 copper wire is laid on the surface of the specimen at the point where the electrodes will touch. This wire initiates the arc and is replaced for each shot, but the reapplication or restrike of the electrodes is made on the test surface without a copper wire. A standardized arc duration of $\frac{1}{2}$ sec has been selected for this test and the electronic timer is adjusted to give this timing. The cycle counter, shown connected across part of the 1-ohm resistor, indicates the actual duration of each arc.

The arc is applied on the test surface by holding down PB-1 and PB-2. The electrodes are reapplied to the test surface after 2 sec, and if it has become conducting, another arc will occur. It has been observed, however, that this second arc will sometimes burn away the conducting area. The test procedure, therefore, specifies two restrikes; if the first one throws an arc, an arc on the second restrike is the sign of failure.

If the second restrike does not arc, the test is continued by applying more power arcs on the test surface and checking for conduction each time. Testing is stopped if failure does not occur after 15 shots.

A picture of an arc, taken through welder's dark glass, is shown in Fig. 3.

Discussion

Originally, carbon electrodes, spaced 1 in. apart, were used in the tester. Oscillograph studies showed that this arc was unsteady and of variable du-



Fig. 3.—Arc Seen Through Dark Glass.

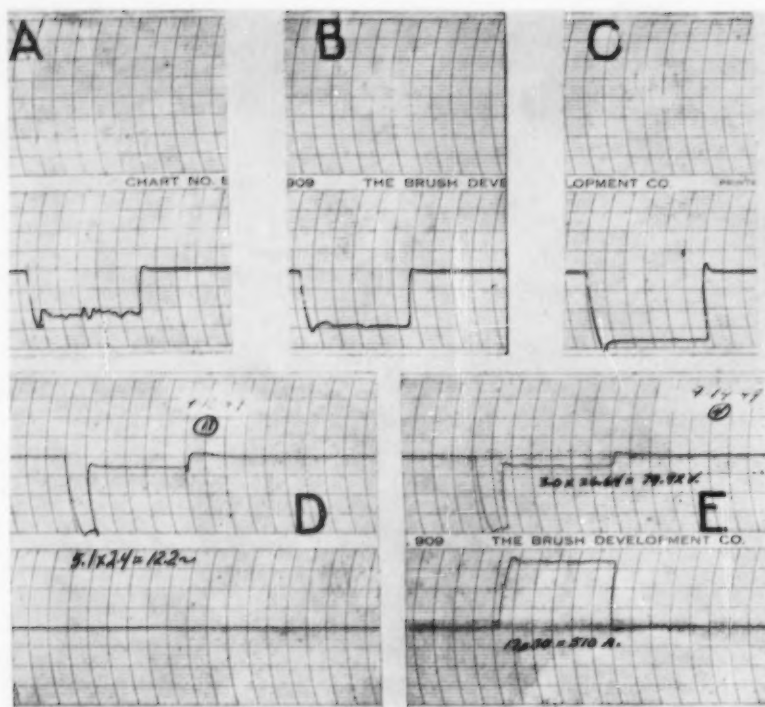


Fig. 4.—Oscillograph Records of High-Power Arcs.

ration. These difficulties were corrected by changing to graphite electrodes spaced $\frac{1}{2}$ in. apart. The graphite electrodes, also, did not erode as rapidly as did the carbons. Some typical oscillograms are shown in Fig. 4. These records all measure current as a voltage drop across the 1-ohm resistor.

Record A is an unsteady arc of 13.4 cycles between carbon electrodes at 1-in. spacing. Record B is an arc between carbons at $\frac{1}{2}$ -in. spacing, and in record C the electrodes are graphite at $\frac{1}{2}$ -in. spacing. The small pips at the ends of these records are due to inertia in the pen movement. In some of these oscillograms, differences in duration of arc were found to be related to the thickness of the specimen, and this was traced to the time necessary for the electrode to come down to the surface. A standard electrode spacing of $\frac{1}{2}$ in. above the specimen was chosen and the electrodes were adjusted to this distance whenever necessary. Oscillograms then showed that the average arc duration was within 0.1 cycle of the 12 cycles desired. The voltage drop across the electrodes during an arc is shown in record D. The deep valley in this record, extending for one time graduation, represents the time necessary for the electrodes to come down to the test surface. When the arc starts, voltage between electrodes drops to about 80 v, which is the value required to sustain

the arc. Record E shows both current and voltage drop. These curves show that current flow does not start until the electrodes have actually made contact with the surface wire.

In following this test procedure, it seemed that the residue of the copper starting wire had no effect on the arc-resistance values. Possibly discrete particles are deposited without connection between them, so that no continuous path is produced. To overcome any objection to the presence of the copper, it should be possible to initiate the arc by a high-voltage impulse between electrodes, which will break down the gap and pilot the power arc.

In this test the high-power arc resistance is defined as the number of arcs required to produce a conducting surface, up to a total of 15 shots. Values of high-power arc resistance obtained on tests of various materials are given in Table I.

TABLE I.—HIGH-POWER ARC RESISTANCE OF INSULATING MATERIALS.

	Arc Resistance Shots
Laminates:	
Asbestos cloth—polyester copolymer.....	1
Glass—melamine.....	15 ^a
Glass—silicone A.....	1
Glass—silicone B.....	2
Asbestos—phenolic.....	1
Paper—phenolic.....	1
Cotton—phenolic.....	1
Sheets:	
Vulcanized fiber.....	15 ^a
Silicone Rubber A.....	14
Polytrifluorochloroethylene.....	15 ^a
Polytetrafluoroethylene.....	15 ^a
Synthetic resin bonded mica plate.....	15 ^a
Molding Materials:	
Asbestos—melamine.....	10
Wood flour—melamine.....	2
Alpha cellulose—melamine.....	15 ^a
Cotton—melamine.....	4
Cotton—melamine phenolic.....	1
Glass—melamine.....	15 ^a
Alpha cellulose—urea A.....	14
Alpha cellulose—urea B.....	4
Wood flour—urea A.....	15 ^a
Wood flour—urea B.....	10
Mineral—alkyd A.....	1
Mineral—alkyd B.....	1
Mineral—alkyd C.....	3
Glass—polyester.....	1
Glass—silicone.....	1

* No failure.

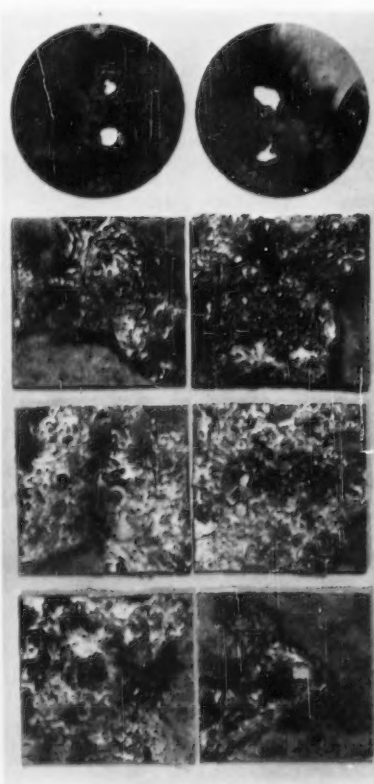


Fig. 5.—Specimens after Testing.

Some of the tested specimens are shown in Fig. 5 where the severe action of the high-power arc is evident. The data in Table I show that this test confirms industrial experience on the high-power arc resistance of many materials. Neither vulcanized fiber nor glass melamine Micarta fail under this test after 15 shots. Phenolic laminates fail after one arc. A polyester-copolymer lami-

nate, which showed good low-power arc resistance, failed after one arc in this test, as it did in actual service.

Summary

A test has been described which measures the resistance of insulating materials, in sheet and tube form, to the formation of surface conducting paths when subjected to high-power arcs. Test conditions and results are reproducible and so far they agree with results in actual service. Since this is a high-power arc test, it does require

a power source of large capacity. The results of this test should provide reliable information about high-power arc resistance of materials for design engineers.

REFERENCES

- (1) H. H. Race and F. W. Warner, "Measuring the Arc-resistance of Insulating Materials in Air," *G.E. Review*, February, 1935, Vol. 38, p. 97.
- (2) V. E. Yarsley and W. D. Owen,

"Recent Work on Tracking in Solid Insulating Materials," *British Plastics*, April, 1951, Vol. 24, p. 122.

- (3) Administrative Committee on Research, *Some Unsolved Problems*, Am. Soc. Testing Mats., p. 15 (1954).
- (4) T. J. Martin and R. L. Hauter, "Arcing Performance of Plastics Insulation," *Electrical Manufacturing*, April, 1954, Vol. 54, p. 102.
- (5) A. Atwell, "Fundamentals of Flashing of Diesel-Electric Motors and Generators," *Electrical Engineering*, July, 1954, Vol. 73, p. 603.

Effect of Streamlining on Stresses in the Perkins Tensile Strength Briquet for Refined Paraffin Waxes*

By W. P. Ridenour¹ and John R. Bowman¹

AT THE February, 1954, meeting of Section I on Strength Tests of the TAPPI-ASTM Technical Committee on Petroleum Wax, it was voted to recommend publication of a revised tensile strength method,^{2,3,4} embodying a streamlined modification of the Perkins mold,⁵ as tentative ASTM and TAPPI methods. In view of this action, it was thought that a short note on the studies made at Mellon Institute some years ago⁶ on the effects of streamlining on the stresses in a wax briquet while under tension would be of interest and should be in the record.

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¹ Multiple Fellowship of Gulf Research and Development Co., Mellon Institute, Pittsburgh, Pa.

² Proposed Method of Test for Tensile Strength of Paraffin Wax, Appendix VII to Report of Committee D-2 on Petroleum Products and Lubricants, *Proceedings*, Am. Soc. Testing Mats., Vol. 52, p. 371 (1952).

³ "The Petroleum Committee in 1953—A Summary," Section I on Strength Tests of Technical Committee M on Petroleum Wax, *ASTM BULLETIN*, No. 194, December, 1953, p. 31.

⁴ "Report of Activities—TAPPI Divisions and Committees. TAPPI-ASTM Technical Committee on Petroleum Wax, Section I—Strength Tests," *TAPPI*, Vol. 37, No. 4, April, 1954, p. 154A.

⁵ Ralph H. Espach, *Bulletin No. 388*, U. S. Bureau of Mines (1935).

⁶ R. L. Freeburg, A. Felder, R. P. Snyder, and J. C. Tredennick, "Tensile Strength of Waxes," thesis for degree of Bachelor of Science, University of Pittsburgh, Pittsburgh, Pa. (1938).

A review of events leading to adoption of the Mellon modified Perkins mold for the proposed method of test for the tensile strength of paraffin wax.

The old Perkins paraffin wax briquet is noted for the irregular way in which it breaks under tension. Even with very careful handling, breaks often occur

outside of the shank. This, of course, contributes to poor reproducibility and means the loss of a high percentage of briquets out of a given number of measurements. In an effort to overcome these difficulties, the Wax Section of the Gulf Fellowship at Mellon Institute in 1938 undertook a short study of the stresses that occur in the Perkins briquet under tension.⁶ It was found, as might be expected, that the square shape of the old Perkins briquet when under tension

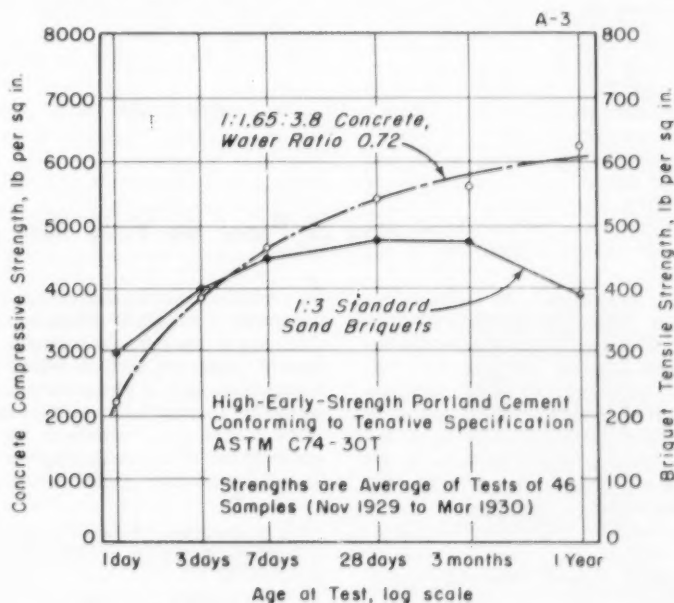


Fig. 1.—Perkins Two-Piece Wax Mold Mellon Modification, for Determination of Tensile Strength.

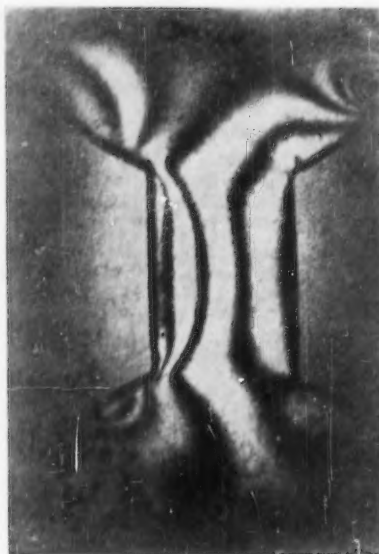


Fig. 2.—Perkins Design Showing Concentration of Stresses at Corners and Throughout Shank Area



Fig. 3.—Mellon Design Entirely Free of Stress Irregularities in the Shank Section.

contains a complex pattern of highly irregular stresses, explaining its erratic behavior on rupture. It was further shown that streamlining smoothed out the stresses and improved reproducibility substantially, and that the breaks could be made to occur at the middle of the shank over a nearly constant cross-sectional area.

The first streamlined mold used by the Mellon Institute Laboratory for routine testing had a narrower and thicker shank than the old Perkins mold, but

the same cross-sectional area at the mid-point of the shank. Experience with this mold was very good, and for several years it was used exclusively in the work of the Gulf Fellowship on paraffin wax. Later on, the old Perkins molds were streamlined, as shown in Fig. 1. Both the streamlined Perkins mold and the Mellon Institute streamlined mold were used in the second round-robin test in 1951-1952 for tensile strength as conducted by Section I of the TAPPI-ASTM Technical Com-

mittee on Petroleum Wax. This work showed that the agreement between the two was very good and that both streamlined molds were much superior to the old Perkins mold with respect to the type and position of the fracture obtained and reproducibility of results.

Stress Analysis

Transparent bakelite models were used to determine the stress distribution developed in briquets of the Perkins and the Mellon designs. The forms were rough cut from a sheet of $\frac{1}{4}$ -in. bakelite and filed to fit the molds. A buffing wheel was used to give a smooth finish, and the internal stresses were relieved in an annealing oven. The annealed models were then placed under tension in a polarized-light machine and photographed.

The Perkins design (Fig. 2) shows a concentration of stresses at the sharp corners and throughout the shank area. It is believed that this condition is responsible for the erratic break pattern commonly associated with this design. The Mellon design (Fig. 3) is entirely free of stress irregularities in the shank section and, as expected, the breaks occur uniformly at the minimum cross-section.

On the basis of these results, the modified design was adopted by the Gulf Fellowship Laboratory for all tensile strength testing of refined wax. Tensile strength test data indicate that the elimination of sharp corners reduces the number of irregular breaks and breaks outside of the shank, and improves the precision of the test.

Discussion of Paper on Yield Rate of Mild Steel¹

R. K. BERNHARD.²—In his highly interesting paper, "Yield Rate of Mild Steel," Frederick Forscher describes experiments showing primarily the relationship between yield rate and temperature. He mentions in his introduction that upper and lower yield points are also a function of the stiffness of the loading mechanism with respect to the stiffness of the specimen.

The range of "dynamic instability"

for various elasticities and various loading speeds of testing machines has been discussed in two previous papers by the writer,^{3,4} however, without taking temperature changes of the specimen into account. It could be shown that under certain conditions, variations in the shape of the stress-strain diagram—in particular at the yield points—are

produced, which are independent of the specimen material. In extreme cases one or both yield points may vanish completely.

It might be valuable to make experiments which include all these parameters. In other words, the influence of the rigidity and speed of the testing machine as well as the influence of the elasticity and temperature of the specimen should be determined.

Such comprehensive investigations should indicate the relative significance of these four variables with respect to the yield rate.

¹ Frederick Forscher, "The Yield Rate of Mild Steel," ASTM BULLETIN, No. 205, April, 1955, p. 63 (TP 89).

² Professor of Engineering Mechanics, Rutgers University, New Brunswick, N. J.

³ R. K. Bernhard, "Influence of the Elastic Constant of Tension Testing Machines," ASTM BULLETIN, No. 85, October, 1937, p. 14.

⁴ R. K. Bernhard, "Automatic Speed Control for Tension and Compression Testing Machines," ASTM BULLETIN, No. 106, October, 1940, pp. 31-34.

Photochemical Degradation of Automobile Lacquers

By Roger L. Saur

THE introduction of durable, fast-drying lacquers for automotive finishes in the early twenties marked an important advance in surface coating technology. In the intervening years, improvements in both pigments and vehicles have greatly extended the duration of effective protection and attractive appearance of lacquer coatings.

Despite the higher cost of application, the five automotive divisions of General Motors have continued to use lacquer as a finish because of its superior characteristics as compared with other finishes. Neither lacquer nor any other finish is weatherproof, however, and efforts toward further improvement are continuing.

As automobile owners know all too well, the bright showroom finish of a new car gradually fades and loses its luster when exposed to the weather. In fact, under special conditions of natural weather, an automotive finish will undergo visible deterioration after only a few months of exposure. This deterioration, which is not limited to lacquers, is seen as gloss loss, rubbing off of pigment, etc., and is popularly called "chalking."

Weathering Factors

When this research program was started, sunlight and dew were considered the most important weathering factors; rain and water vapor or humidity were next; the effect of thermal shock was not well established. This information along with that available in the technical literature gave a few facts with which to start a research program. The basis for this program was that a fresh lacquer film on exposure to various weathering factors was known to deteriorate and the amount could be estimated either visually by noting gloss and color changes or by the use of glossmeters which detected only the gloss changes. Although the combination of the weather factors was known to cause deterioration, the relative contribution of each component was not well known because "weather" changes much more rapidly than paint deterioration rates. For this reason it was considered necessary to control separately the vari-

Experiments show that ordinary weathering is due to light, oxygen, and water. A proposed deterioration mechanism accounts for these, of which the absence of any one greatly inhibits degradation.

ous weathering factors over long periods of time in an artificial exposure apparatus.

Exposure Apparatus

The source of radiant energy was a 1000-w high-pressure mercury arc lamp, emitting 500 w of light in the visible and ultraviolet regions. Light from this lamp after passing through an ultraviolet transmitting window was allowed to fall on each paint panel (18 in. from the lamp) inside its brass box. The source of atmosphere inside each box was either room atmosphere or a commercial compressed gas. The air or the selected gas, that is, nitrogen (Seaford grade), oxygen, or carbon dioxide, was passed through either a drier (magnesium perchlorate) or a humidifier (water bubbler) before entering its exposure box. Air pollutants such as sulfur dioxide were not used in this investigation. Gas flow was controlled at each box outlet by a flowmeter. Many panels were exposed simultaneously to nullify fluctuations of light intensity. Deterioration of the paint panels was compared by both appearance and gloss.

Causes of Deterioration

The investigation revealed that the only factors in weathering that contribute to the deterioration are sunlight, oxygen, and water vapor or humidity. The relative concentration of each determines the deterioration rate. Without light no loss of glossiness occurs. Without oxygen, deterioration is extremely slow. Oxygen without water vapor results in somewhat more rapid deterioration. The deterioration rate approaches that of natural weather conditions only when all three factors are present.

Light varies not only in intensity but also in wavelength. The effect of various colors on the decomposition rate was determined by using a grating monochromator and a high-pressure mercury arc lamp, the same as that used on the exposure apparatus. Various lacquer panels were exposed to the spectrum (which ranged from the far

ultraviolet 2500 Å to the infrared or 10,000 Å). This work showed that light of longer wavelength than green (about 5000 Å) has little, if any, detectable effect on lacquer decomposition. However, light of shorter wavelength than green light does deteriorate lacquer. In fact, the shorter the wavelength the greater the deterioration rate becomes. This means that it is not necessary to shield the coating from all wavelengths in sunlight. If a method could be found which removes only the ultraviolet light, very little deterioration would take place. For a number of years various attempts have been made to find materials which when added to paint vehicles would absorb the ultraviolet light. However, the attempts were unsuccessful, probably because of the extremely short distances in which the ultraviolet light must be absorbed. Light penetrates a paint film probably to about 0.001 in. The ultraviolet light must be stopped in appreciably less distance than this in order for the blockage to be effective.

Thus, at present, it is not feasible to shield the coating from the factors of weather responsible for its deterioration. One field of endeavor remains: to alter the lacquer binder so that the deterioration reaction would be prevented from occurring even if exposed to the weathering factors. In order to attack this problem, it is necessary to know about the chemical reactions which take place during deterioration. This will be discussed later in this article.

Since the chalking deterioration can be detected before it becomes visible, this part of the naturally occurring process was labeled the "latent exposure period." When water is poured onto a panel that has not been deteriorated, the water stands up on the surface in



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drops, indicating that water does not wet the surface. After some nonvisible deterioration by weather has occurred, the water spreads out in a thin film, showing that water wets the surface. Further exposure of the panel results in a visibly deteriorated surface which is also wet by water. The reason for this change is the decrease of nitrate concentration on the surface.¹

Products of Deterioration

Continued exposure results in deterioration products which can be investigated in three forms: (1) as the deteriorated surface itself, (2) as evolved gases, and (3) as washings collected from the deteriorated surface.

Deteriorated Surface.—Inspection of the deteriorated surface itself by eye and by glossmeters has already been mentioned. When light falls on a panel, the amount of light reflected by the paint panel is estimated by a photocell unit. If the paint panel has lost some of its glossiness, the light is scattered to a greater extent, and therefore less light strikes the photocell, yielding a correspondingly smaller meter reading. This type instrument is used widely in the paint industry.

Chalking can also be measured by polarized light. Light is polarized when reflected from a plane surface of any nonconducting material. If a polarizing filter is rotated in a light beam reflected at the polarizing angle from glass, the light transmitted through the filter varies in intensity. The amount of light not polarized on reflection is that light which is transmitted at the minimum intensity, whereas that transmitted at the maximum intensity includes

light that is polarized as well. The ratio of minimum to maximum reflected light gives the ratio of scattered to scattered plus polarized light. A perfect dielectric surface should result in a ratio of zero. Light reflected from a surface of white paint pigment is not polarized at all, resulting in the above ratio equaling one.

The polarized light effect is measured in a goniophotometer which contains a large outer light-tight housing into which a narrow pencil of light is introduced. A paint panel mounted on a magnetic holder in the center of the instrument can be rotated about a vertical axis. The light reflected from the panel is measured by means of a photocell, ahead of which are mounted a condenser lens and a polarizer. Provision is made to rotate the photocell arm independently about the same axis as that of the paint panel. The incident and reflection angles are set at the polarizing angles, about 57 deg. The amount of unpolarized light is found by determining the intensity of the light transmitted through the polaroid filter for various positions of rotation of the filter about the optic axis. For a new glossy panel, the unpolarized light reflected is of the order of 0.01 per cent. For a badly chalked panel this ratio increases to about 85 per cent. By proper usage of reflection constants of pigment and vehicle, these ratios could probably be corrected to give the ratio of surface covered by pigment.

The interference microscope can be used to measure a surface change—the amount of thickness lost on exposure. It is based on the phenomenon of interference fringes which are formed when an optical flat is placed next to, but at a small angle from, a fairly flat surface.

These interference fringes can be thought of as profile lines of the nonflat surface and are extremely sensitive to small variations in elevation and depression of that surface. The interference microscope is essentially a microscope to which an interferometer has been added. By using this instrument, the elevation changes of small portions of a surface can be determined. Figure 1 shows an interferogram, taken at a magnification of 250, of a section of paint film including an exposed and unexposed portion. A control scratch ruled on the unexposed portion indicates that the black interference lines bend downward to indicate a depression in the surface. Inspection of the lines across the boundary between the unexposed and exposed portions shows that the exposed portion had lost thickness. Knowing that the difference in elevation between adjacent interference lines is about 10 microinches for the mercury green light used, it is possible to measure the amount of thickness loss. As the deterioration becomes increasingly severe, the interference lines reflected from the deteriorated surface gradually become more diffused until finally they merge with the background. This method of measurement cannot be used on a panel that has this much deterioration.

Figure 2 is a graph obtained by measuring the thickness loss at various time intervals during the exposure of a blue fast-chalking lacquer exposed in air to a high-pressure mercury arc lamp. The first hour of exposure in which no thickness was lost probably corresponds to the latent exposure period. That the loss ultimately approaches a maximum is probably due to shielding of the vehicle underneath by the white pigment held in the surface.

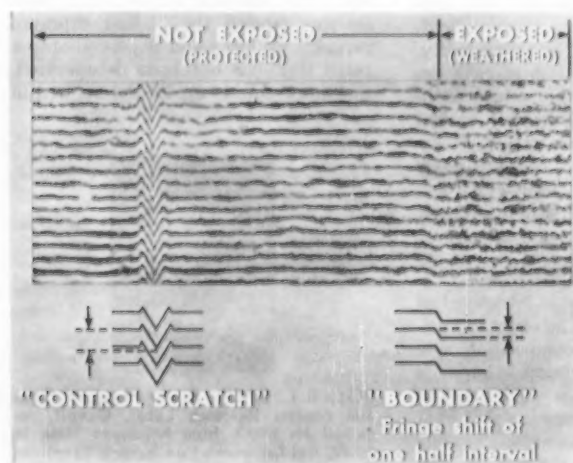


Fig. 1.—Interferogram from Paint Film Surface, $\times 250$.

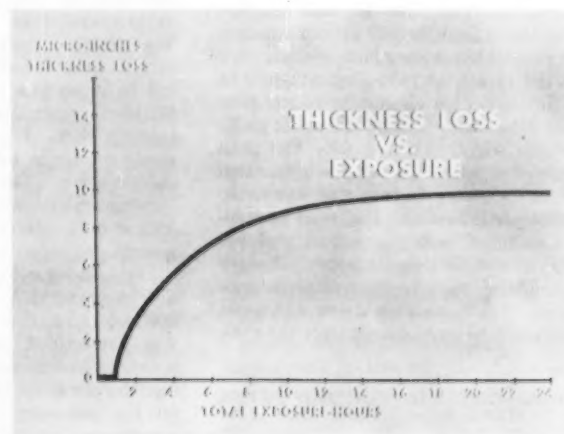


Fig. 2.—Thickness Loss of a Blue Lacquer.

¹ F. E. Bartlett and B. Roger Ray, *Journal, Am. Chemical Soc.*, Vol. 74, pp. 778-783 (1952).

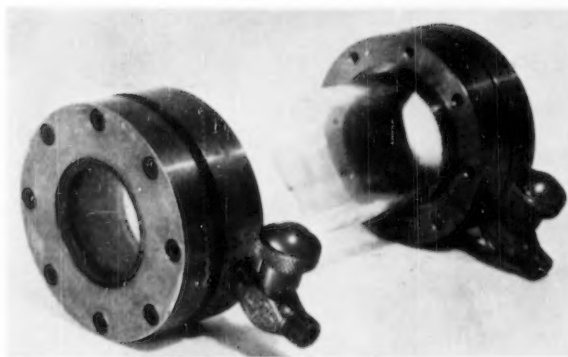


Fig. 3.—Gas Cell for Infrared Analysis.

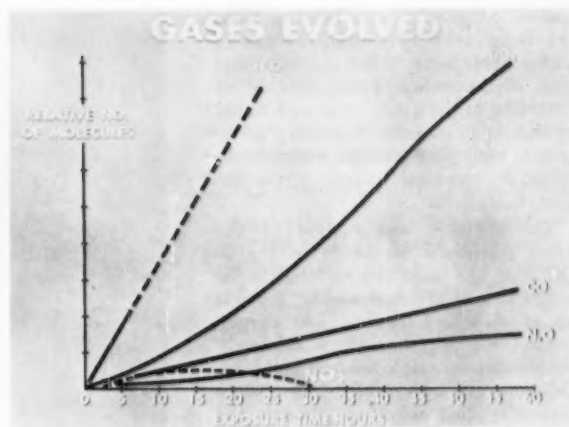


Fig. 4.—Analysis of Evolved Gases.

When a lacquer film is exposed for a long period of time without washing, dipping it into water results in immediate gloss loss. This is due to the dissolving of that part of the vehicle which has been decomposed into water-soluble components. The amount of this material on the surface can be estimated by determining the ultraviolet absorption of the solution. The amount of absorption indicates the relative amount of residue dissolved, or the amount of decomposition that has taken place.

These methods of deterioration analysis depend on two fundamental changes of a weathered lacquer film: (1) exposure of pigment on the surface, determined by visual observation, gloss measurements, and polarized light, and (2) erosion of vehicle on the surface resulting either in gaseous or water-soluble products. The amount of material removed is indicated by thickness loss and by the amount of decomposed vehicle made water-soluble.

The first approach depends on the amount of exposed pigment and uses gloss loss, color change, and the ratio of nonpolarized light to totally reflected light. Results obtained utilizing this effect, however, are affected by the amount of pigment in the paint and by the size of the pigment particles. A second approach is to measure the loss of vehicle from the surface of the paint film by use of the interference microscope, or to determine the amount of water-soluble residue in the surface by measuring the amount of ultraviolet light absorbed by the washings. These methods were tested by rating automobile lacquers in varying states of deterioration. The three methods depending on pigment exposure agree quite well with each other. However, preliminary experiments showed no

agreement between this method and the thickness loss measurements and the amount of water-soluble residue removed. Neither did the last two agree, possibly because the latter method disregards gases evolved during the decomposition.

Evolved Gases.—The evolved gases have been analyzed by infrared spectroscopy and found to include water and carbon dioxide, as well as small amounts of carbon monoxide (CO), nitrous oxide (N_2O), nitric oxide (NO), and nitrogen dioxide (NO_2). To do this analysis a special infrared cell was constructed (Fig. 3). The windows at each end of the cell are of sodium chloride, or rock salt, to pass infrared radiation. The body of the cell is a fused quartz tube which passes ultraviolet radiation for deteriorating a clear lacquer film within. After the film was placed in the cell and the windows tightened into position, the desired atmosphere was introduced before exposure by purging the cell through pet cocks. Thus, at various intervals while the cell was being exposed to radiation of a high-pressure mercury arc lamp, the evolved gas was analyzed. The amount of each gas present can be estimated by determining how much infrared radiation is absorbed at its characteristic wavelength.

A graph of the analysis is shown in Fig. 4. Water was formed in the greatest quantities. The line for water vapor is solid only up to a certain point because at this point water vapor started to condense; the line was extrapolated in a straight line because the other gases of oxidation were also formed at a nearly linear rate. Carbon dioxide was also formed in relatively large quantities. The curve for NO (not shown on the graph) was of the same shape as, but of lower intensity than, that of NO_2 .

It can be seen from the shapes of the curves of NO and NO_2 that these gases further react with something else. The importance of these gas analyses will be brought out later.

The chemical changes that take place in an unpigmented film on exposure can also be followed by infrared analysis. A clear lacquer film was exposed to the light of a high-pressure mercury arc lamp, and at various intervals during its exposure the film was analyzed by infrared absorption. It was shown that nitrate was lost from the film and that cellulosic acid was formed.

Water Washings.—Cellulosic acid is also found in the collected washings from the paint surface. When an unwashed deteriorated surface is rinsed with water, the washings are found to contain deterioration products. On evaporating to dryness, an aromatic residue remains, the odor of the residue being very much like that of hot maple syrup.

Infrared analysis was made possible by blending or mulling the water-soluble residue into a mineral oil of approximately the same refractive index and dispersion as the material so that light scattering was decreased enough to obtain a usable spectrum. This demonstrated the presence of cellulosic acid with smaller amounts of cellulose nitrate.^{2,3}

X-ray analysis showed cellobiose was also present, along with cellobiose in one case. This was not detected by means of the infrared analysis because there was probably not enough present. Conversely, the X-ray did not show the presence of cellulosic

² E. C. Yackel and W. O. Kenyon, *Journal, Am. Chemical Soc.*, Vol. 64, pp. 121-131 (1942).

³ J. W. Rowen, C. M. Hunt, and E. K. Plyler, *Journal of Research, Nat. Bureau Standards*, Vol. 39, pp. 133-140 (1947).

acid or cellulose nitrate because these two compounds were probably not in a crystalline form. The empirical formula of these three compounds mixed according to the quantity of each found by infrared analysis, however, corresponds very closely to the elements obtained by chemical analysis of the residue, $C_6H_{10}O_5N$.

The chemical composition of the solids concerned is shown in Fig. 5. Cellulose, the main raw material in the production of cellulose nitrate, is made up of carbon, hydrogen, and oxygen atoms tied together in a relatively simple structure repeated over and over. Cellulose can be considered as glucose molecules tied together through the removal of water at each junction. There may be as few as 2 or as many as 250 glucose units in a single cellulose molecule. When cellulose is converted to cellulose nitrate by treatment with a nitrating agent such as nitric acid, some of the hydroxyl (OH) groups are replaced by nitrate (NO_2) radicals.

Mechanism of Deterioration

The postulated mechanism is as follows:

Cellulose nitrate + weathering \rightarrow cellulose

Cellulose + $NO_2 \rightarrow$ celluronic acid

Cellulose + light + oxygen \rightarrow celluronic acid

On exposure to the necessary weathering factors, the cellulose nitrate in lacquer deteriorates to cellulose (verified by X-ray analysis) with evolution of the nitrogen oxide gases. It is postulated that simultaneously some of the pairs of hydrogen atoms on the external carbon atoms are replaced by an oxygen atom in some of the molecules. This is possible either through oxidation by NO_2 gas or by atmospheric oxygen on irradiation. (The NO_2 -cellulose reaction is discussed in the literature.^{2,3}) The oxygen reaction was performed in the GM laboratory by merely exposing filter paper, which is pure cellulose, to radiation from a germicidal mercury lamp. Washing this air-exposed material leaches out a water-soluble product which by infrared analysis was shown to consist of cellulose and celluronic acid.

This reaction postulates that cellulose is the intermediate product between cellulose nitrate and celluronic acid. The presence of cellulosic materials was shown by X-ray analysis. We also know that when cellulose is treated with certain oxidizing agents the product is celluronic acid. References can be found in the technical literature describing the oxidizing effect on cellulose of nitrogen dioxide.^{2,3} This ni-

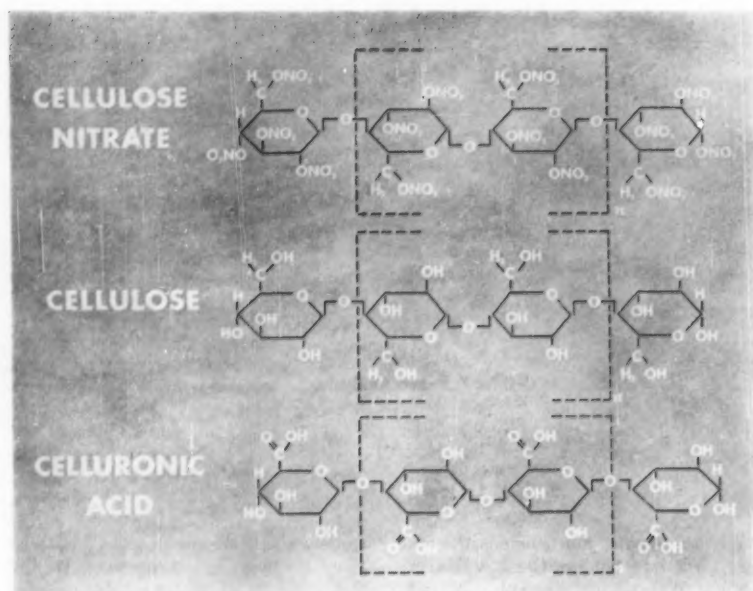


Fig. 5.—Structural Formulae.

trogen dioxide is evolved by weathering lacquer, shown by infrared analysis. One of the major oxidation products of this reaction is celluronic acid. Nitrogen dioxide is a very effective oxidizing agent based on the amount of celluronic acid produced. It has also been demonstrated that cellulose irradiated in air is oxidized to produce celluronic acid.

At the beginning of this paper it was pointed out that light, oxygen, and water vapor were all necessary for the decomposition of lacquer. Necessity for light is accounted for in the first reaction.

In the last reaction the necessity for oxygen is obvious, as it is also in the NO_2 oxidation when it is recalled that NO , formed when NO_2 oxidizes another substance, is in turn reoxidized to NO_2 by the atmospheric oxygen. It was demonstrated by using the infrared cell previously discussed that no nitrogen oxides were evolved in an oxygen-filled cell in which the water was removed as fast as it formed. Therefore the first reaction indicates that the weathering factors necessary to deteriorate cellulose nitrate to cellulose probably include water also. This could mean that nitric acid is given off in the reaction even though it could not be detected chemically or by ultraviolet absorption. It is known that nitric acid in the presence of light breaks down to give nitrogen dioxide. The gas may even be formed beneath the top surface of the lacquer and the time required for

the gas to diffuse away from the surface may give it a chance to react with the cellulose formed in the denitration.

The last reaction given above was not attempted in the absence of oxygen. However, since oxygen is the major oxidizing agent in the atmosphere, it was assumed that this was the agent which oxidized cellulose to celluronic acid.

Summary of Results

The results of work described herein indicate that the nature and mechanism of automobile lacquer chalking is as follows:

The weathering factors—light, oxygen, and water vapor—all contribute toward lacquer gloss loss, the rate being more or less dependent on the relative amount of each component and on the wavelength of the light. The lacquer film gradually loses thickness on exposure, probably due to erosion of vehicle from the surface. This erosion may be attributed partly to evolution of gases and partly to removal, on washing, of water-soluble deterioration products. Thus, the pigment in the surface of the film becomes more and more exposed as deterioration progresses. The colored pigment, being generally of smaller particles, is also sloughed off with the vehicle, thereby exposing the larger white pigment particles held by the vehicle. A roughened surface results which scatters reflected light, and is characterized by loss of gloss and of reflected image resolution. This light scattering, coupled with loss of colored

pigment, also results in a whitened surface. The best example is lacquer maroons which before about 1948 earned for themselves a bad name because of their rapid gloss loss and whitening.

The nitrocellulose decomposition probably proceeds as follows:

Cellulose nitrate, in the presence of light, is hydrolyzed to cellulose and simultaneously oxidized to liberate certain gases. This removal of vehicle exposes surface pigment, the resulting

surface having less gloss. The NO_2 in the gases evolved, as well as atmospheric oxygen in the presence of light, is capable of oxidizing the cellulose to celluronic acid, the major solid deterioration product identified. As cellulose and celluronic acid are both somewhat water-soluble, the action of rain and dew is to further expose the surface pigment and continually renew the vehicle surface for further deterioration.

This material has been presented in the nature of a preliminary report since

further work remains to be done. It is hoped that this information will be of use in the development of finishes which better resist photochemical deterioration. It is also hoped that further papers covering more details of this work will be published.

Acknowledgment:

Suggestions and contributions of members of the General Motors Research Laboratories is hereby gratefully acknowledged.

Photooxidative Degradation of Alkyd Films

By E. B. FitzGerald

THE foremost objective of the present work was to develop information that would lead to the synthesis of more durable alkyd resins. As a second objective it was expected that methods of measurement and testing would be developed that could be used to estimate the durability of new polymers and finishes in shorter time and more reliably than any of the presently available methods.

The investigation started with a qualitative examination of the gross physical effects that result from exposure of a protective coating to outdoor weather or, in general, to photooxidative conditions. It proceeded with an attempt to measure these effects quantitatively in relation to the conditions that produce them. Finally, an effort was made to establish some of the chemical mechanisms that are involved. The results, which follow, will be presented in this same general order.

Materials and Methods

The resin used in most of the work was a typical automotive alkyd of 50 per cent oil length (6 parts linseed to 1 part tung oil) and an acid number of 18. When used with no modification other than a common drier, this will be referred to as "clear alkyd." Pigment was used in some of the experiments and will be specified where it occurs. Films were also prepared from fatty-acid esters of glycerol and pentaerythritol. These were obtained from the

The physical effects of degradation in alkyd films have been quantitatively related to the conditions and chemical mechanisms that produce them.

Hormel Institute as part of a cooperative research program sponsored by the Paint and Varnish Production Clubs. Their synthesis has been reported elsewhere (1).¹ Other materials will be described where they occur.

Films were sprayed or doctor bladed on glass slides or steel panels using a solution of the resin in hydrocarbon solvent. Unless otherwise designated, all films were baked at 125 C for 20 min and stored for one month before use. Free films for measurement of mechanical properties were prepared by spraying and baking the clear alkyd on steel panels coated with polytetrafluoroethylene. The films were then lifted from the panels, cut to required dimensions, and stored for one month prior to use.

Four light sources were employed in the work: (1) a 125-w Hanovia quartz mercury vapor lamp; (2) a 360-w Uviarc quartz mercury lamp; (3) a Westinghouse 40-w fluorescent ultraviolet lamp, and (4) a 1000-w water-cooled General Electric AH-6 lamp with Pyrex jacket. The spectral energy distributions from these sources were measured with a quartz monochromator-thermopile-amplifier arrangement and will be specified where pertinent. Whenever filters were used in combination with one of these sources, their absorption spectra were measured, and the spectral distributions of light actually reaching the specimens were calculated.

Results and Discussion

Gloss Loss.—Deterioration of a finish which is exposed to natural weather can manifest itself in various ways. Cracking, blistering, and peeling, for example, are important aspects of the problem, but in the present work, major attention has been given to the phenomena that result in disappearance of the lustrous surface which characterizes an unexposed finish. An electron microscope view of this effect, popularly known as gloss loss or, in advanced stages, as chalking, is shown in Figs. 1 and 2.

From simple, qualitative observation, it has been concluded that the loss of gloss is concomitant with the appearance of pigment at the surface. This conclusion is borne out by electron diffraction studies of pigmented enamels at various stages of weathering. Thus, a fresh, high gloss surface—shown in Fig. 1—shows no evidence of pigment under electron diffraction, while a chalked surface—shown in Fig. 2—gives a clear, strong pattern characteristic of the pigment. Examination at intermediate stages of weathering has shown that the first perceptible appearance of a pig-



E. B. FITZGERALD, Fabrics & Finishes Department, E. I. du Pont de Nemours & Co., Inc., Experimental Station, Wilmington, Del., has been studying photooxidative degradation of organic films since 1950.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ The boldface numbers in parentheses refer to the list of references appended to this paper.

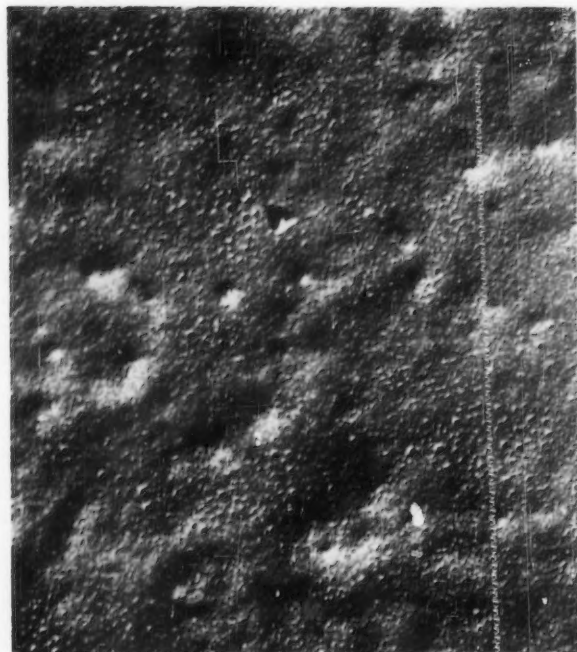


Fig. 1.—Electronmicrograph of Pigmented Alkyd Film Before Exposure.



Fig. 2.—Electronmicrograph of Pigmented Alkyd Film After 3 Months in Florida.

ment diffraction pattern occurs before any change can be detected by the unaided eye. These patterns appear at about the same time standard reflection instruments are showing the first perceptible loss in gloss and also about simultaneously with the first appearance of the protrusions seen in the electronmicrograph.

Effect of Light Intensity.—Experience has shown that exposure to light is a necessary condition for the degradation processes that lead to loss of gloss and chalking. Since this clearly implies a photochemical process, it becomes of interest to examine the relationship between the rate of gloss loss and light intensity. A schematic diagram of an experimental arrangement to determine this relationship is shown in Fig. 3. The specimens consisted of 4 by 3-in. steel panels coated with the standard alkyd resin containing 20 per cent rutile pigment by volume. A set of four panels could be exposed simultaneously to radiation from a Uviarc lamp at well-separated levels of intensity; intensity at each level was established by prior measurement using a calibrated photocell device. Water at 25 C was circulated over the panels, since no other way of maintaining a known and constant temperature at the panel surfaces could be devised. Light reflection at the air-water interface was calculated from the Fresnell equation and appropriate cor-

rections were applied. Constancy of lamp performance throughout the experiment was determined by periodic photocell measurements.

The panels were taken from the water periodically and gloss was measured using the du Pont Universal Gloss Meter (2). Results, averaged from several experiments, are shown in Fig. 4. Taking the reciprocals of the times required to reach various levels of gloss loss, it was found that the average rates so obtained were well represented by Eq 1, where R represents gloss units per hour, E is relative incident light intensity and k is a constant. This is shown in Fig. 5.

$$R = kE^{0.83} \dots \dots \dots (1)$$

It will be shown later that this relationship with light intensity is identical to

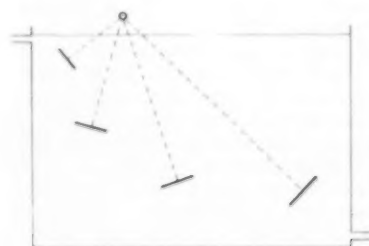


Fig. 3.—Schematic Diagram of Apparatus for Exposing Films to Various Light Intensities.

that obtained for the rate of evolution of volatile decomposition products.

Effect of Wavelength.—Investigation of the relationship between wavelength and degradation is much more difficult than the intensity effect. In the present work, test panels, coated with the same enamel that was used in the intensity measurements, were exposed under various filters to the radiation of a Hanovia lamp. Exposures were carried out, under dry, open air conditions, simultaneously and at uniform distance from the lamp by use of a turntable arrangement. Under these conditions the panels maintained a uniform temperature of about 40 C. Relative values of the light distribution incident upon each panel (Table I), were calculated from the measured output of the lamp and the transmission characteristics of the filters. It was found that spectral output of the lamp changed throughout its lifetime, and the only remedy found for this was to replace the bulb at intervals during the experiment.

Gloss loss of the panels, measured periodically, is shown in Fig. 6. In an effort to unify and correlate these results in the simplest possible manner, it was assumed that if the average rate of gloss loss up to 20 units of loss were to be taken from Fig. 6, then Eq 1 would still hold and the relation including wavelength λ might be represented by some function of $E_{\lambda}^{0.83}/\lambda^n$ summed over

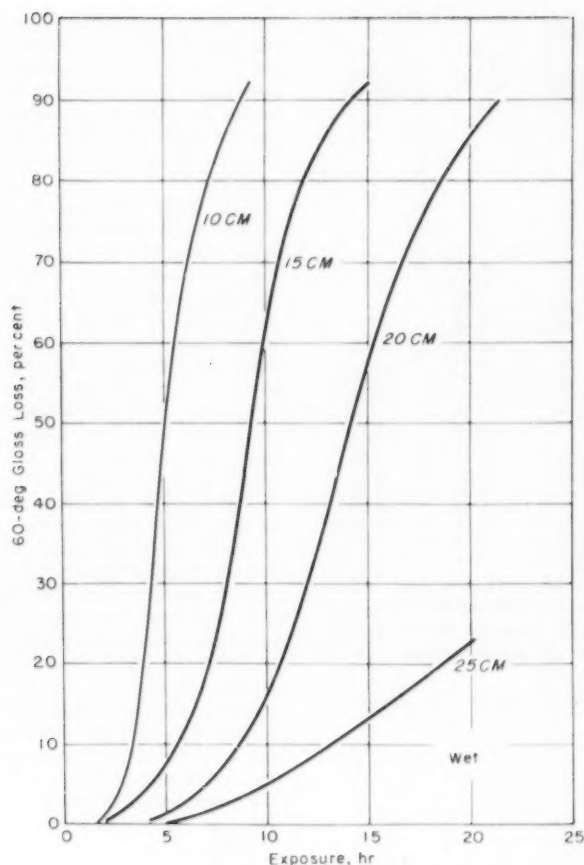


Fig. 4.—Gloss Loss Found at Various Light Intensities.

all wavelengths given in Table I. Accordingly, Eq 2 in which A and B are constants, was found to be in approximate agreement with the data, as shown in Fig. 7.

$$R_{\lambda, \tau} \approx A \left[\sum \frac{E_{\lambda}^{0.8}}{\lambda^4} \right] + B \left[\sum \frac{E_{\lambda}^{0.8}}{\lambda^4} \right]^2 \dots (2)$$

Equation 2 represents merely an attempt to express empirically the relationship between gloss loss and wavelength. It is nevertheless instructive to compare this equation with one derived for the ultraviolet transmission on a clear film of the same resin. The specific extinction, k , of the clear alkyd is shown in Fig. 8, together with a plot of the relation:

$$k = \frac{1}{d} \log \frac{I_0}{I} = \frac{C}{\lambda^4} + \frac{D}{\lambda^8} \dots (3)$$

where d is film thickness and C and D are constants.

Although there appears to be some deviation from Eq 3 in the region of shorter wavelengths, the agreement throughout most of the range is quite

reasonable and suggests that the average rate of gloss loss (up to 20 units loss) in monochromatic light is proportional to the specific extinction. This conclusion may be applicable to films other than alkyds, for it is in general

agreement with the results given by Long (3), who found that the durability of a variety of films could be correlated with the area under a transmission curve between 3000 and 4000 Å. Exceptions would be found in the case of materials containing structures of very low light transmission and very high resistance to photolysis.

Surface Erosion.—Up to this point, no attempt has been made to define the means by which the chemical processes of photolysis result in the geometrical effects of surface roughness and eventual appearance of pigment particles. It has been implied, however, that matter is being lost by the film through photo-initiated scission reactions that lead ultimately to volatile decomposition products. It would appear simple to detect loss of material as loss in weight, but experiments have shown that, under certain circumstances the weight loss incurred up to the point of chalking may be too slight to measure accurately. For example, if it is assumed that a measurable amount of gloss loss or chalking would be produced by loss through volatilization of the uppermost 0.05 μ of the organic film material, the corresponding weight loss for a reaction confined strictly to the surface, would be 0.2 per cent in a 1-mil film. By the use of interferometry, the disappearance of such small amounts of material can be determined more conveniently and accurately than they can by weighing.

The interferometric method can be applied very simply. In the present work a sharp line of demarcation between an exposed and unexposed film area was produced by laying a double-edged razor blade on the film and positioning an ultraviolet lamp vertically above it. Upon exposure, the unpro-

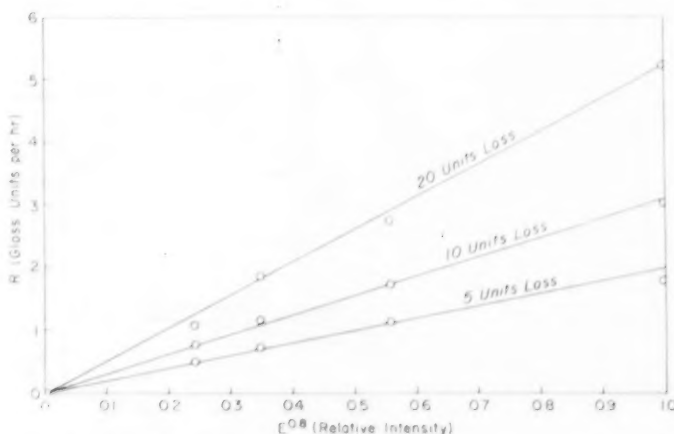


Fig. 5.—Relationship Between Rate of Gloss Loss and Incident Light Intensity.

TABLE I.—RELATIVE ENERGY DISTRIBUTIONS FROM HANOVIA LAMP WITH VARIOUS CORNING FILTERS.

Wavelength, $m\mu$	No Filter	Filter No. 791	Filter No. 986	Filter No. 970	Filter No. 774	Filter No. 733
205	0.15	...	...	...	...	...
215	0.45	0.05	...	...	...	...
225	1.00	0.22	...	...	...	...
235	1.70	0.82	...	...	...	...
245	2.45	1.62	...	...	...	...
255	4.70	3.57	0.15	0.05	...	...
265	5.75	4.77	0.75	0.29	...	...
275	2.40	2.09	0.70	0.38	...	...
285	2.05	1.85	0.98	0.72	...	...
295	5.60	5.10	3.41	3.25	0.22	...
305	7.70	7.10	5.54	5.77	0.84	...
315	9.70	9.04	7.46	8.05	2.32	...
325	0.30	0.28	0.23	0.27	0.12	...
335	1.50	1.39	1.18	1.37	0.79	...
345	0.15	0.14	0.12	0.14	0.10	0.02
355	0.30	0.28	0.23	0.28	0.24	0.20
365	18.60	17.30	14.00	17.10	14.90	12.10
375	0.46	0.43	0.29	0.43	0.38	0.38
390	0.20	0.18	0.07	0.20	0.18	0.18
405	4.30	4.00	...	3.96	3.90	3.90
420	0.20	0.18	...	0.18	0.18	0.18
435	7.05	7.55	...	6.50	7.41	6.41
495	0.25	0.23	...	0.23	0.23	0.23
545	5.12	4.76	...	4.72	4.65	4.65
560	0.15	0.14	...	0.14	0.14	0.14
575	4.00	3.72	...	3.68	3.64	3.64
585 and up	1.30	1.21	...	1.20	1.18	1.18

ected film decreased in thickness relative to the protected part and a step was formed at the boundary; the height of the step was then measured by means of a Tolansky microinterferometer (4, 5, 6). Figure 9 shows typical fringe

shifts obtained with the clear alkyd upon exposure to the unfiltered Hanovia lamp and Fig. 10 gives the result of a series of such measurements plotted against time.

When measurements of this type were

carried out on the standard alkyd pigmented with 25 per cent rutile and compared with gloss measurements, it was found that the relationship between decrease in thickness and gloss loss depended upon the wavelength distribution of the light source used for the exposure.

With direct radiation from the Hanovia or Uviarc lamps, the ratio of thickness decrease to gloss loss was smaller than that obtained when the light from these lamps was filtered by a glass, such as Corning No. 970 (Table I), although in the latter case the change took place much more slowly. Decrease in thickness can, of course, result from increase in density, and measurements on the clear alkyd after very drastic exposure indicated that shrinkage up to 3 per cent can be accounted for in this way. It follows that thickness decreases of the magnitude shown in Figs. 9 and 10 could be attributed entirely to change in density unless this change were measured and shown to be negligible or unless the initial film thickness was so small that the decreases upon exposure exceeded the maximum attributable to density effects.

Both of these procedures were applied in the present work and decrease in thickness due to net loss of material was demonstrated. It was concluded that gloss loss and chalking of a pigmented

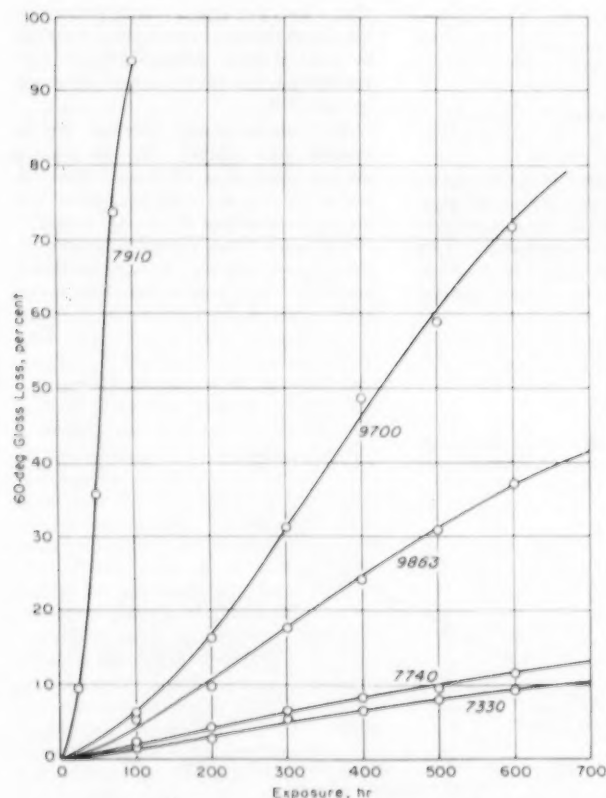


Fig. 6.—Gloss Loss Found with Various Light Distributions.

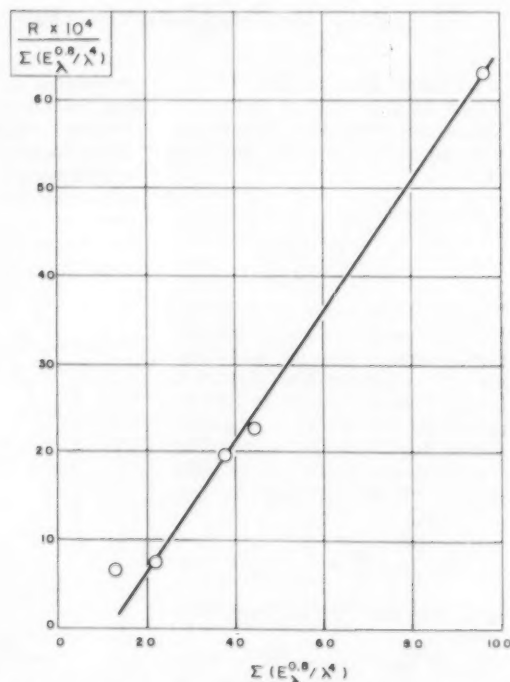


Fig. 7.—Relationship Between Rate of Gloss Loss and Incident Light Distribution.

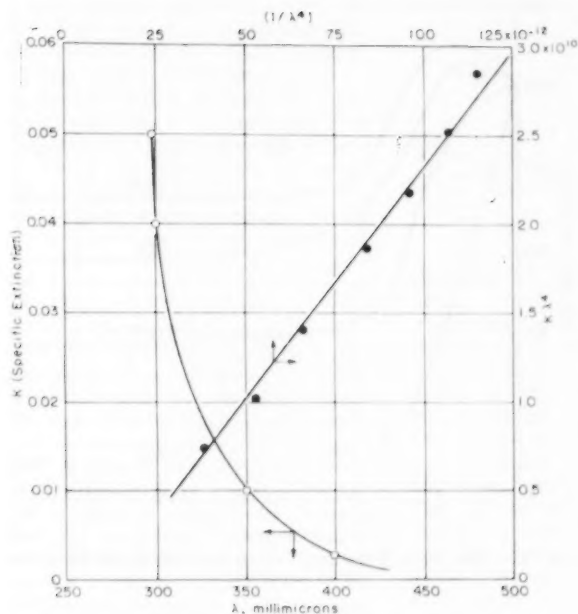


Fig. 8.—Specific Extinction of Alkyd Film.

alkyd result when a sufficient depth of binder has been eroded from the surface by conversion to volatile products. Radiation from the unfiltered Hanovia lamp attacks the surface so rapidly that chalking becomes evident before the bulk of the film has had time to undergo severe degradation. With the filtered Hanovia lamp, attack is slower and, despite the shielding effect of pigment, the radiation penetrates the film sufficiently to cause degradation and loss of volatile products from beneath the surface. Thus, for equal extents of gloss loss, the film exposed to the filtered lamp will have lost more matter in the form of volatiles. The same situation with regard to loss of volatiles obtains for clear film, but the effects penetrate deeper and, although the surface is roughened, true chalking cannot occur.

Analysis of the Film.—The most direct and obvious way of getting information about the chemical nature of degradation is through analysis of the film before and after exposure to photooxidative conditions. No single method is capable of yielding all the necessary information and consequently several techniques were used in this work. One of the most outstanding characteristics of baked alkyd films—their insolubility in all but the most drastic solvents—not only guided the selection of techniques but limited the effectiveness of some that were attempted.

Infrared spectroscopy proved to be one of the most generally informative analytical methods. Films of clear alkyd were cast and baked on rock salt;

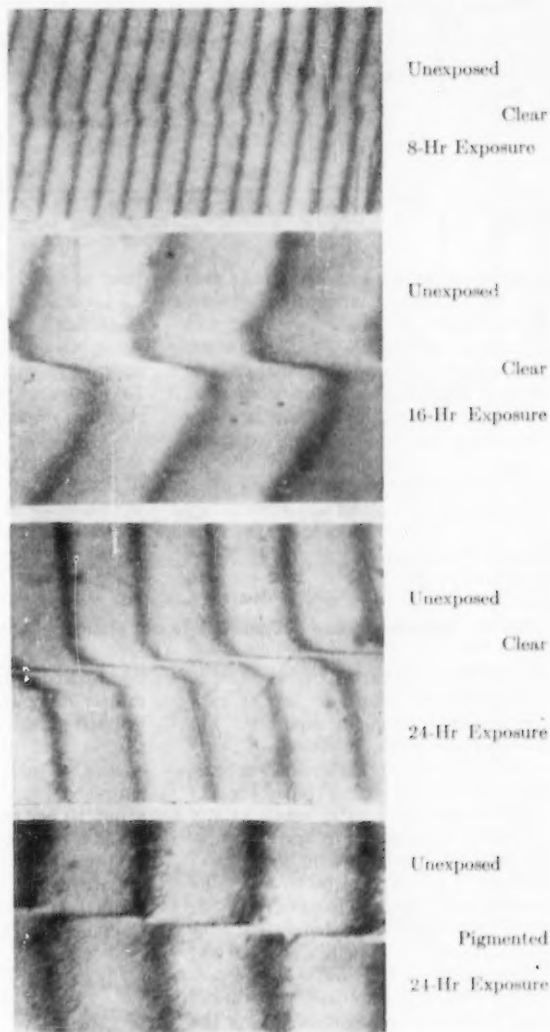


Fig. 9.—Interference Fringe Shifts Produced by Exposure.

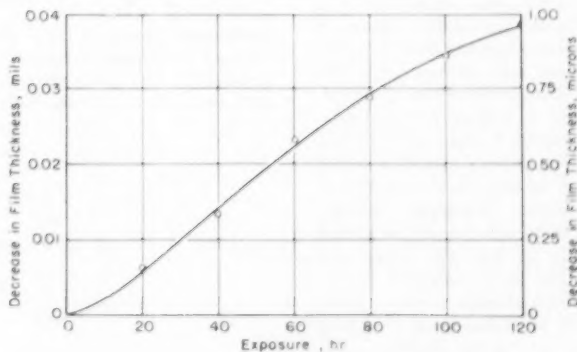


Fig. 10.—Decrease in Film Thickness Resulting from Exposure.

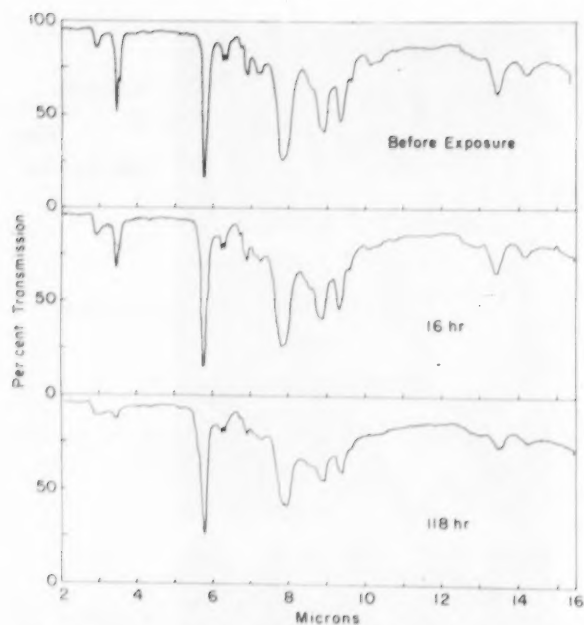
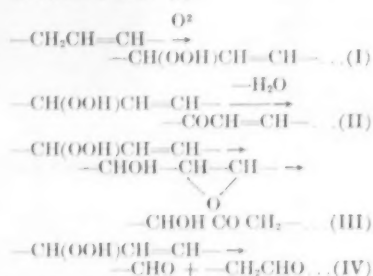


Fig. 11.—Infrared Spectra of Films Before and After Exposure.

spectra were taken before exposure to photooxidative conditions and at various periods throughout exposure. For the purposes of the present work, only a few of the absorption maxima appearing in the unexposed film (top of Fig. 11) need be identified. The bands at 2.9, 3.4, and 5.8 μ represent hydroxyl groups, aliphatic carbon-hydrogen bonds, and carbonyl groups respectively. The doublet at 6.3 and the bands at 8.9, 9.3, 13.5, and 14.2 μ are characteristic of phthalate esters. The bands at 6.9 and 7.2 are due to $-\text{CH}_2-$ and $-\text{CH}_3$ respectively, while the deep band at 7.8 arises from carbon-oxygen-carbon links of the ester. There was no evidence of olefinic unsaturation in any of the spectra. The weak bands found from 10 to 10.5 μ also occurred in alkyls modified with pure stearic acid and therefore cannot be attributed to unsaturation.

The changes in composition that were produced by exposure depended upon the nature of the irradiating source, as might have been expected from the work on gloss loss and erosion. Certain qualitative similarities were observed, however, and a typical example produced by exposure to the General Electric AH-6 lamp (intense radiation above 3000 Å) may be seen in the spectra of Fig. 11. Major structural changes evident in these spectra are analyzed quantitatively in Fig. 12. Here, the immediate and rapid decrease in aliphatic carbon-hydrogen content must be attributed to replacement of drying oil hydrogen atoms by hydroxyl, hydroperoxide and carbonyl groups. As the degradation proceeds, and the car-

Formation of oxygenated structures can, of course, take place at sites of original unsaturation in the oil as in reactions I to IV (7):



Oxidation occurring only at sites of original unsaturation cannot, however, account for the gross changes that are observed. Even if reactions such as

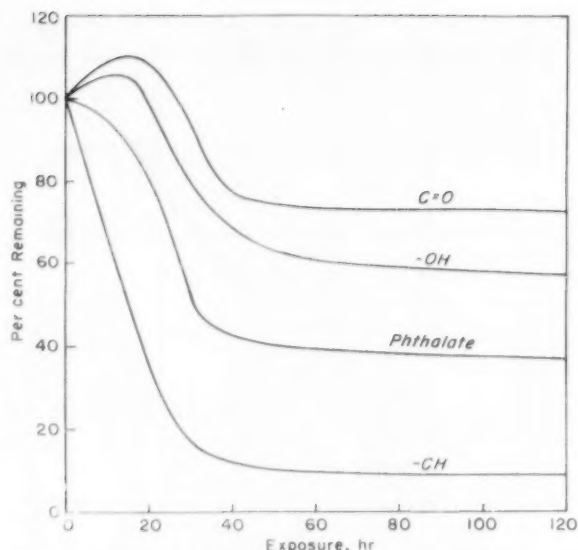
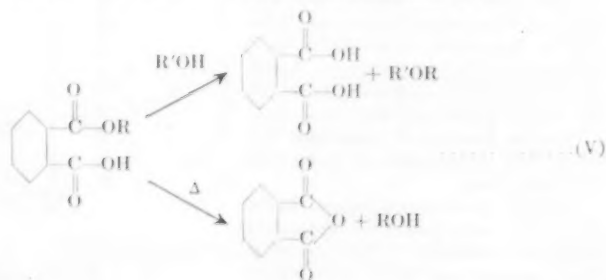


Fig. 12.—Changes in Functional Group Concentrations Resulting from Exposure.

III and IV have not eliminated unsaturation during the bake, the decrease in carbon-hydrogen is so extensive that random or repetitive degradation processes capable eventually of attacking any or all of the oil hydrogens must be postulated. This does not imply that the degradation is unrelated to the original unsaturation for, in fact, an alkyl synthesized from pure stearic acid showed practically no change in composition, even after prolonged exposure. Degradation of a drying oil alkyl apparently starts during the bake with the formation of hydroxyls, hydroperoxides, and polyketones at the sites of original unsaturation. Exposure to light results in photolysis of these groups followed by complex oxidation mechanisms in which similar groups are generated and subsequently photolyzed along the remainder of the oil molecule.

During the period of rapid carbon-hydrogen disappearance, the spectra also show a slower decrease in phthalate content of the film. Appearance of phthalic anhydride at the surface of alkyd films or, for that matter, in unopened cans, has been noted under certain circumstances and has been attributed to reactions such as V:



In the present work, evidence in favor of photooxidative loss of phthalate was found in several ways: films exposed to varying degrees of degradation, as indicated by weight losses up to 25 per cent, were analyzed chemically for phthalate ester content using the method of Shreve and Heather (8). In every case, the oxidized film contained the same weight per cent phthalate (within the limits of experimental accuracy) as the original resin. Also, exposures to the direct radiation of a Hanovia lamp were made on films prepared from an alkyd analogous to the standard clear resin, but possessing carbon-14 in the phthalate carboxyl position. Complete elementary analyses were made on these films, and CO_2 obtained from combustion was precipitated as barium carbonate and analyzed. Results of this work (Table II), indicate a small preferential loss of phthalate. It is also apparent that loss of hydrogen during exposure to the Hanovia lamp was accompanied by loss of carbon in nearly the same atomic ratio as existed in the original film. In the dark, however, hydrogen was lost relatively faster than carbon.

It is concluded that oxidation whether photo or thermal initiated, begins in the oil part of the molecule and spreads to the glyceryl and phthalate ester structures such that, on the average, complete alkyd monomeric units are disappearing together. This suggests that phthalate content of the oxidized film may be applied to the infrared analyses as an approximate internal standard. Consequently, replotting the data of Fig. 12 relative to phthalate content should give an indication of the changes in functional group concentrations corrected for decrease in film thickness (Fig. 13).

As mentioned earlier, chemical analysis of the film is greatly handicapped by its insolubility; however, chromatographic analyses of benzene-alcohol extracts of exposed film did reveal the presence of diketones and quinones. Attempts to estimate ethylenic unsaturation by hydrogenation and other means gave erratic results. Qualitative tests, however, were most instructive. For example, films partly exposed to the Hanovia lamp and partly protected, would, upon immersion in aqueous potassium permanganate, acquire a layer of manganese dioxide upon the exposed area, while the unexposed area remained clean. Similarly exposed films immersed briefly in aqueous iodine-potassium iodide and then in a starch solution turned blue on the unexposed area, while the exposed area remained colorless. One possible explanation for the formation of unsaturation during

TABLE II.—ELEMENTARY ANALYSIS AND RADIOASSAY OF CARBOXYL-TAGGED ALKYD FILMS.

Exposure	Carbon, per cent	Hydrogen, per cent	Oxygen, per cent	Ratio, Hydrogen to Carbon	Relative Activity per Weight Carbon
None	64.00	7.28	28.72	1.37	100
72 hr direct Hanovia ultraviolet	63.75	7.32	28.93	1.37	94.4
72 hr at 120°C in dark	62.76	6.70	30.54	1.28	95.2

photolysis will be offered in the next section.

Analysis of Volatile Products.—Gravimetric analyses of volatile products were carried out using apparatus similar to that ordinarily employed for semimicro elementary analysis; details and procedure have already been published (4). Alkyd films of known area and weight were placed in a quartz tube and exposed to filtered or unfiltered radiation from a Hanovia lamp in a gentle stream of oxygen or purified nitrogen. The effluent gases were converted to carbon dioxide and water, caught in absorption tubes, and weighed daily for ten days.

One of the most significant conclusions of this work resulted from comparison of the hydrogen-carbon atomic ratio in the off-gases to that in the parent material. When films were exposed to the unfiltered radiation of the Hanovia lamp in oxygen, the hydrogen-carbon ratio in the gases was approximately 2.5 (compared to 1.35 in the film), while use of filtered radiation (Corning No. 970) gave ratios that ranged from 5 to 7, although, of course, the gases were evolved much more slowly. The lower ratios produced by the unfiltered radiation are in agreement with the conclusions obtained from interferometry to the effect

that short wavelengths result in total removal of organic material from the film surface. High hydrogen-carbon ratios produced by filtered radiation confirm the infrared and elementary analyses quoted previously by demonstrating that dehydrogenation is one of the important initial effects of photolysis in the bulk of the film.

Another significant result of the gravimetric work was realized by plotting the total weight of gases evolved in a given period of time versus the weight of resin per unit area. Such a plot is shown in Fig. 14, which is a composite of results obtained with various light sources. It is important to note, also, that when plotted in this way, data for pigmented and clear films fell on the same lines. The dotted line in Fig. 14 represents the quantity of gases that would be evolved upon total combustion of the film to carbon dioxide and water. Thus, the graph indicates that clear films thinner than about 0.3 mg per sq cm disappear completely in 100 hr of exposure to the unfiltered Hanovia, while with pigmented films, only the pigment remains. Similarly, it is concluded that a thicker film exposed to the unfiltered Hanovia for the same period of time loses approximately 0.3 mg per sq cm from its surface and, in addition, loses material in

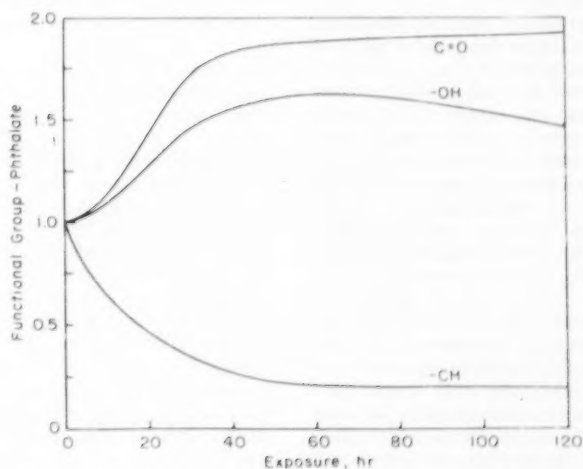


Fig. 13.—Changes in Functional Group Concentrations Relative to Phthalate Content.

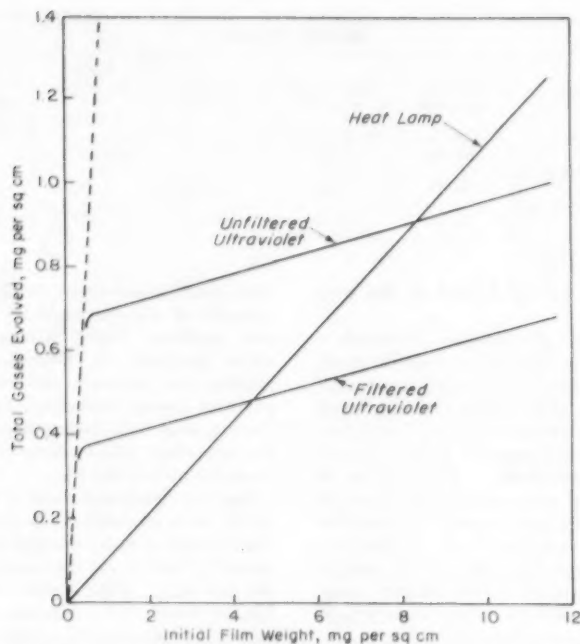


Fig. 14.—Gases Evolved from Alkyd Films During 100 Hr of Exposure to Various Light Sources.

the form of volatiles from beneath its surface.

Figure 14 also shows that a film exposed to radiation from which some of the short wavelengths have been filtered loses a smaller amount of material from its surface, while the loss from beneath the surface is the same as that experienced by a film of identical thickness exposed to the total radiation. Finally, films exposed to a lamp producing intense radiation in the visible and infrared but probably nothing less than 4000 Å evolve volatile degradation products in a manner characteristic of a simple bulk reaction.

The amount of chalking produced from these three exposure conditions was in agreement with that found in the studies of the wavelength effect; films exposed to the unfiltered Hanovia chalked severely in 100 hr, while those exposed to the filtered Hanovia chalked slightly and those exposed to the heat lamp gave no detectable loss in gloss. Changes in thickness calculated from Fig. 14 agreed satisfactorily with results obtained by interferometry.

A quite different and, in certain respects, more informative means of studying volatile products was accomplished by the use of the infrared spectrograph. Exposure cells were constructed from 10-cm lengths of 5-cm (outside diameter) borosilicate glass tubing equipped with side arms and stopcocks; rock salt windows were cemented to the ends. Films coated on

microscope slides were placed inside the cells, where they could be exposed to radiation from a Westinghouse fluorescent ultraviolet lamp through the cell wall without obstructing the infrared beam used for analysis.

A typical result obtained in these experiments is shown in the spectrum (Fig. 15) of gases produced by a dry film of pentaerythritol eleostearate after 5 days' exposure in an oxygen atmosphere. The relationship between light intensity and rate of gas evolution was determined by placing the cells at various distances from the light source, where the relative intensities were measured by a photocell, as in the chalking experiments. The optical density of the carbon dioxide absorption band was determined periodically and converted to pressure by calibration. Rate calculations from these data gave the same functional relationship to intensity (Eq 1) that was obtained for the rate of chalking.

The effect of wavelength distribution was studied by placing filters over the cells; output of the lamp and transmission of the filters are given in Fig. 16.

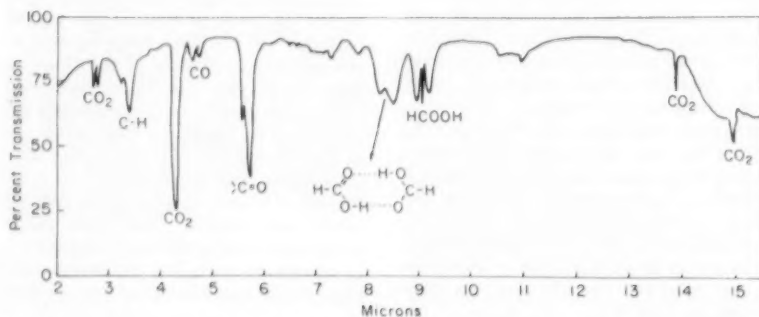


Fig. 15.—Infrared Spectrum of Gases Evolved from Dried Film of Pentaerythritol Eleostearate Upon Exposure to Light.

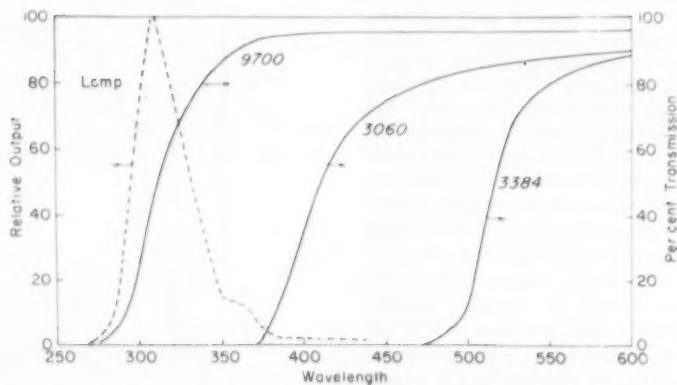


Fig. 16.—Characteristics of Westinghouse Ultraviolet Fluorescent Lamp and Filters Used in Gas Evolution Experiments.

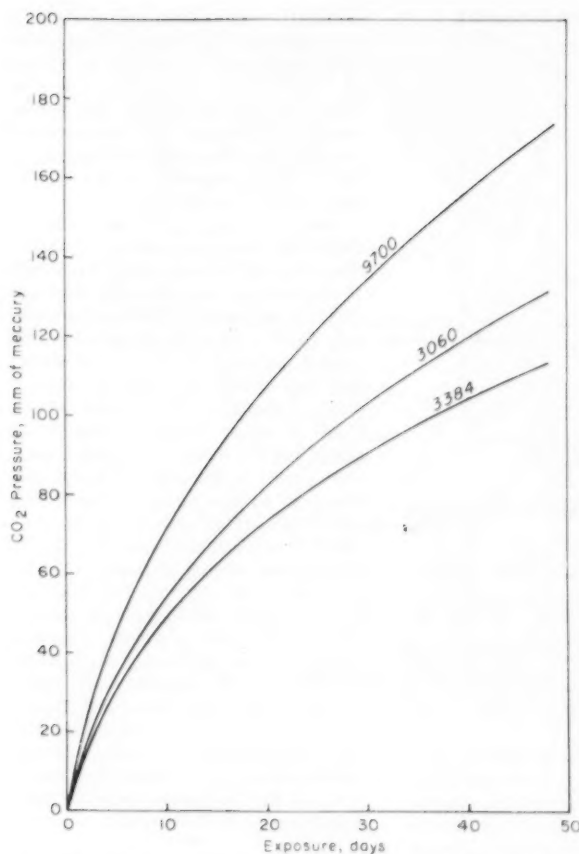


Fig. 17.—Carbon Dioxide Evolution from Dried Film of Pentaerythritol Eleostearate Upon Exposure to Various Light Distributions.

Results for dried films of clear pentaerythritol eleostearate are given in Fig. 17, which clearly shows the somewhat surprising importance of the reactions due to longer wavelengths. Qualitatively it would appear from Figs. 16 and 17 that the rate of gas evolution from clear films is less dependent upon wavelength than is the rate of chalking in pigmented films. Intuitively, it might be supposed that longer wavelengths are just as effective as the shorter ones in producing volatile products but that their effect is distributed through a greater depth of film. Additional work will be needed to clarify this point and, in particular, the modification that is to be expected from the presence of pigment.

In view of the complexity of alkyd resin films, it is difficult to draw detailed inferences regarding the mechanism of deterioration from experiments on the films themselves. The use of compounds that can serve as models for the various structures present in alkyds provides a means of overcoming this difficulty. For example, it was shown earlier that baked films contain little unsaturation

and it was suggested that initial attack by light consists of photolysis of ketones formed during the bake. Further evidence in support of this view was sought by infrared analysis of the volatile degradation products arising from various model compounds during exposure.

Air-dried films of pentaerythritol esters of eleostearic, linolenic, linoleic, oleic, and stearic acids were exposed in the infrared gas cells with an oxygen atmosphere. Area and thickness of the films, distance from the Westinghouse fluorescent lamp, and all other exposure conditions were held constant. Carbon dioxide, carbon monoxide, formic acid, and water were found in every case, and no other products were detected. Also, the relative amounts of the various gases were approximately the same for all the films, but the rates of evolution depended upon the amount of unsaturation originally present in the ester, as shown by the data for the carbon dioxide absorption bands in Fig. 18. When the films were baked prior to exposure, the data corresponding to Fig. 18 were

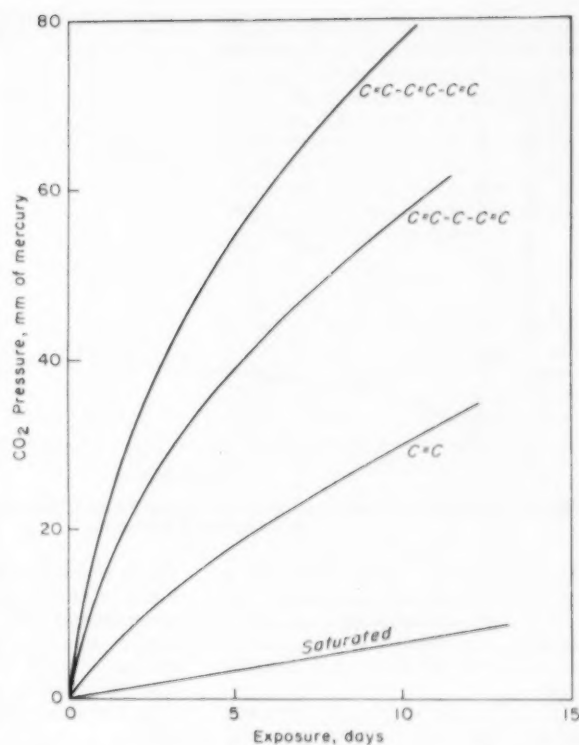


Fig. 18.—Carbon Dioxide Evolution from Dried Films of Drying Oil Esters Upon Exposure to Light.

compressed downward (except for the saturated ester which remained constant), but the same relationship between the rates was maintained.

If gas evolution is, in fact, a result of ketone photolysis, then the reaction should proceed—or at least commence—in the absence of oxygen. In order to test this point, two identical dried films of pentaerythritol eleostearate were exposed to the Westinghouse lamp in the infrared cells. One cell was filled with oxygen and the other with nitrogen; both cells were evacuated and refilled with their respective initial atmospheres at approximately two-week intervals, while their contents—between intervals—were monitored by infrared. The results (shown in Fig. 19) suggest that two reactions are involved: (a) photolysis of existing oxygenated groups and (b) oxidation of residual unsaturation or of unsaturation and free radicals created by the photolysis. Both reactions stopped immediately (so far as could be detected) upon removing the cells from the light.

Exposures of stearic and sorbic acids were carried out as thin layers of powder in the oxygen-filled gas cells. Here, the sorbic acid decomposed rapidly to give carbon dioxide, carbon monoxide, water, formic acid, and acetic acid.

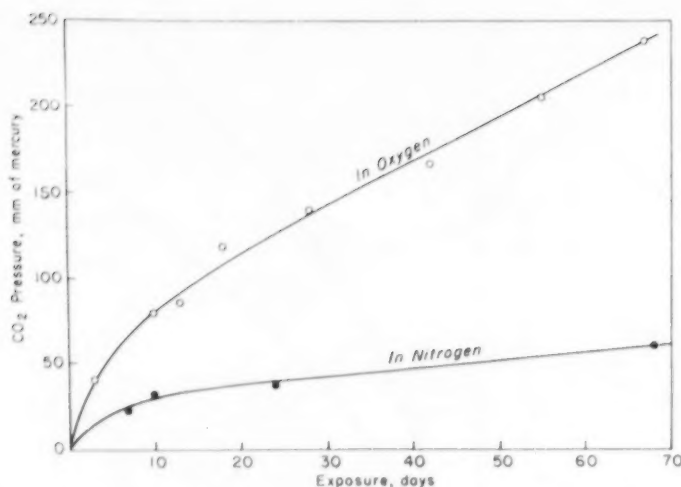
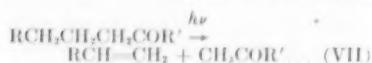
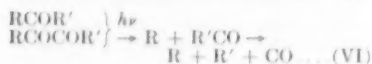


Fig. 19.—Evolution of Carbon Dioxide from Dried Films of Pentaerythritol Eleostearate in Oxygen and Nitrogen.

Also, the residue from the sorbic acid, a viscous, yellow liquid, was found to contain a high concentration of hydroxyl groups. The stearic acid, by contrast, proved to be very resistant to degradation.

From these results, and all of the foregoing, it was concluded that: (a) Initial attack by light occurs at ketonic groups that have been formed prior to exposure through hydroperoxidation and rearrangements at the sites of original unsaturation. (b) Ketonic or carboxyl carbonyls conjugated with ethylenic unsaturation or with other carbonyls are more readily attacked, particularly by radiation above 3000 Å, than are isolated carbonyls. (c) The initial attack does not require the presence of oxygen, but proceeds by the well-known mechanism (9) shown in reactions VI and VII:



(d) In the absence of oxygen, the available carbonyls are eventually consumed and the rate of degradation is drastically reduced. With oxygen present, however, the radicals formed in reaction VI further react to give carbon dioxide, water, and formic acid (9, 10). Furthermore, the lower ketone formed in reaction VII is subject to repetition of both reactions, while the olefin can proceed, via the usual hydroperoxidation, to give more ketone. Radicals formed in reaction VI can also combine with similar radicals on nearby chains to yield new cross-links. It is probable that these radicals are capable of abstracting hydrogen from sensitive points (such as α-methylenes and tertiary hydrogens)

and in this way spreading the destruction to parts of the structure not directly susceptible to photolysis. (e) The existence of substantial concentration of ketonic carbonyl is the most probable cause of yellowing that is observed in alkyd films upon drying or aging in the dark.

Mechanical Properties.—Up to this point, the major concern has been with attempting to explain the mechanism by which an alkyd film undergoes loss of gloss and chalking upon exposure to photooxidative conditions.

Normally, however, degradation is accompanied by other effects, the most important of which is change in mechanical properties. Accordingly, as a conclusion to the present work, a brief study was made in order to relate the observable changes in certain of these properties to the mechanism already postulated.

Clear and pigmented free films 2.5 mils thick were prepared as previously described and cut into strips 1 cm wide. Permanent set measurements were carried out by exposing specimens to radiation from a Hanovia lamp while they were maintained at 10 per cent elongation and 100 C in a quartz-windowed oven. Clamps were applied to the strips at inked reference lines 10 cm apart, and the strips, with their clamps, were placed in the oven for a few minutes prior to attachment to the stretching frame. The oven could be evacuated or maintained with any desired atmosphere during exposure. Lamps were placed 10 cm from the specimens in such a way as to provide uniform illumination. At various intervals, specimens were unclamped and allowed to relax for a few minutes while still in the oven; they were then removed and allowed to relax at room temperature until constant length, as measured by a cathetometer, was obtained. Permanent set was calculated from the equation given by Andrews (12):

$$\text{Permanent set, per cent} = \frac{s - u}{x - u} \times 100$$

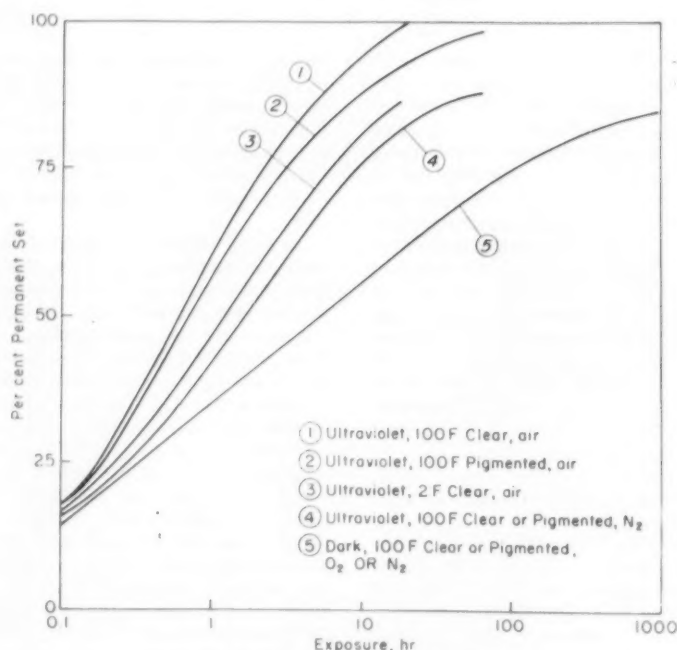


Fig. 20.—Permanent Set Results.

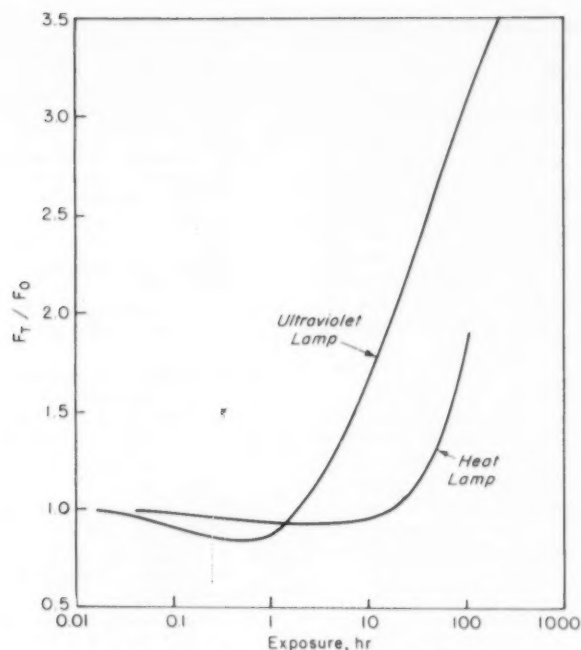


Fig. 21.—Intermittent Stress Relaxation.

where:

- u = the original distance between reference marks,
- x = the distance when the specimen was stretched on the frame, and
- s = the distance after exposure and relaxation.

The results (Fig. 20) give a relative estimate of the number of new, permanent bonds (cross-links) formed by chemical reaction while the specimens were elongated. In the direct comparison between clear films and pigmented films containing 25 per cent by weight of either rutile or anatase, the clear films experienced slightly greater permanent set than did those with pigment, but no difference could be distinguished between the two pigments. This means that the cross-linking reactions penetrated nearly as deeply into the pigmented film as they did into the clear, but it is impossible to infer whether this depth was very slight or comprised nearly the whole film. Exposures in nitrogen resulted in substantially reduced permanent set, and the difference between clear and pigmented specimens could no longer be detected. In the absence of light, no differences due to pigmentation or type of atmosphere could be measured; it is probable that permanent set occurring in the dark results from a simple flow mechanism and does not depend upon the formation of new chemical bonds. The dependence on temperature is shown by one run carried out at 2 C.

According to the mechanisms postulated in reactions VI and VII, chain scission reactions must be occurring simultaneously with cross-linking, but relative rates of the two processes cannot be obtained from permanent set data alone. The net rate of scission and cross-linking can, however, be obtained from intermittent measurements of the modulus of a specimen maintained in a relaxed state during exposure (11, 12). Such measurements were effected by use of a simple electric strain gage apparatus constructed for the purpose. Test strips were cut from the same films and to the same dimensions as those used in the permanent set work; exposures to the unfiltered Hanovia lamp were carried out in air at 25 C. The stress required to elongate the specimens 10 per cent was measured periodically and the ratios of stress at time t to initial stress, F_t/F_0 , were plotted against log time. It should be noted that the lamp was turned off a few minutes before each measurement to avoid any possibility that the specimen was above 25 C at the moment of measurement.

Results of this work (Fig. 21) indicate a slight excess of scission processes over cross-linking at an early stage in the exposure but, following this, the rate of cross-linking increases rapidly and finally becomes one of the outstanding features of photooxidative degradation in alkyd films. It was impossible, in this apparatus, to carry out measurements at controlled temperatures above

30 C. However, replacement of the Hanovia lamp by a 375-w Westinghouse infrared bulb gave cross-linking effects qualitatively similar to those obtained with the ultraviolet source. Finally, measurements were made of stress relaxation at constant elongation, but it was found that molecular flow by diffusion was too large to permit the scission reactions to be isolated.

Summary

The initial step in the degradation of drying oil alkyd enamels occurs during the air-drying or baking stages of film formation. Oxygen attacks the unsaturation in the oil and forms hydroperoxides. These hydroperoxides serve either to initiate the α -methylene chain reaction, which leads ultimately to the formation of useful polymers, or they decompose in side reactions to produce hydroxyl, carbonyl, and other oxygenated groups. The carbonyl groups, especially if they are conjugated with each other or with residual olefinic unsaturation, absorb strongly in the near ultraviolet and significantly at longer wavelengths.

Upon exposure to sunlight, these complex ketones immediately begin to produce carbon monoxide, free radicals, new olefins, and lower ketones. If oxygen is present, the free radicals are oxidized to new photolabile compounds (which may be volatile); the newly formed olefins are subject to repetition of the hydroperoxidation process and the lower ketones continue to be photolyzed until the chain in which they originally existed is consumed. In addition, the free radicals may attack other parts of the alkyd molecule at random or become stabilized by reaction with other radicals. While all of these reactions start in the oil molecule, their damage spreads by repetition until the glyceryl phthalate ester is attacked and ultimately converted into volatile products.

Long before the film is entirely consumed, the effects of this complex chemical process can be observed as physical changes in the film. Very short wavelengths, as from an ultraviolet lamp, are completely absorbed in a very thin surface layer and repetitive reactions proceed rapidly through complete units of the alkyd structure in this layer. Thus, if the incident light is entirely short wavelengths, the major physical effect is an erosion of the surface, which appears as "chalk" if the film is pigmented or as slight dulling in a clear area; in either case, the freshly exposed surface is hydrophilic, due to its high content of polar, oxygenated groups.

When the film is exposed to polychromatic radiation, such as sunlight,

the longer wavelengths penetrate deeper than the shorter ones and initiate reactions throughout the bulk of the film. Here, the photolytic processes are more gradual, and dehydrogenation with the formation of carbonyl groups and cross-links becomes more important than cleavage. Consequently, hydrogen in the form of water is evolved more rapidly from the bulk of the film than is carbon in the form of its oxides and volatile compounds. As a result, shrinkage, increase in density, embrittlement, and yellowing occur in the bulk of the film. These physical effects are diminished by the screening effect of pigment, but radiation in the longer visible and near infrared part of the sun's spectrum penetrates to the substrate interface in the films of ordinary thickness.

The extent of yellowing is dependent upon the relative rates of formation and destruction of ketone and polyketone structures. Since these rates depend, in turn, upon the wavelength distribution of the incident radiation, various light sources produce characteristic equilibrium levels of yellowing. Thus, a film that has acquired a high level of yellowing through exposure to ordinary indoor illumination, or to heat, may be

bleached to a lower level of yellowness in sunlight or to a still lower level by appropriate ultraviolet lamps.

Limited access of oxygen in the bulk of the film undoubtedly has a role in governing the sequence of reactions throughout the film, particularly in the initial stages of drying, but its effects have not been specifically studied. Water vapor appears to have little influence on the degradation processes, but liquid water accelerates chalking by the physical effects of swelling and solution and possibly by chemical interaction as well.

Acknowledgment:

Appreciative acknowledgment is extended to the many research staff members who contributed their technical skills and advice to this work. Special acknowledgment is made to J. T. Harris, Jr., and C. D. Miller for assistance with the infrared work and its interpretation.

REFERENCES

- (1) W. O. Lundberg and J. R. Chipault, *Official Digest*, Fed. Paint and Varnish Mfrs., January, 1944, No. 288, p. 11.
- (2) S. Hochberg and M. P. Morse, *Official Digest*, Fed. Paint and Varnish Mfrs., July, 1950, No. 307, p. 10.
- (3) J. S. Long, *Official Digest*, Fed. Paint and Varnish Mfrs., October, 1949, No. 297, p. 648.
- (4) S. Tolansky, "Multiple Beam Interferometry of Surfaces and Films," London, Oxford University Press (1948).
- (5) E. B. Fitzgerald, *Industrial and Engineering Chemistry*, Vol. 45, p. 2545 (1953).
- (6) W. L. Grube and S. R. Rouze, *Journal, Optical Soc. Am.*, Vol. 44, p. 851 (1955).
- (7) D. Swern, J. T. Scanlon, and H. B. Knight, *Journal, Am. Oil Chemists Soc.*, Vol. 25, p. 193 (1948).
- (8) O. D. Shreve and M. R. Heether, *Analytical Chemistry*, Vol. 23, p. 441 (1951).
- (9) J. E. Guillet and R. G. W. Norrish, *Nature*, Vol. 173, p. 625 (1954).
- (10) A. Finkelstein and W. A. Noyes, Jr., *Discussions, Faraday Soc.*, No. 14, p. 76 (1953).
- (11) M. I. Christie, *Journal, Am. Chemical Soc.*, Vol. 76, p. 1979 (1954).
- (12) R. D. Andrews, A. V. Tobolsky, and E. E. Hanson, *Journal, Applied Physics*, Vol. 17, p. 352 (1946).

Acid Contamination as a Source of Error in Boiling Nitric Acid Test for Corrosion-Resistant Steels

By Robert J. Bendure

THE boiling nitric acid test, ASTM Recommended Practice A 262,¹ has been found useful for measuring the quality of stainless steels with respect to their ability to resist attack by nitric acid and as an indication of the effectiveness of heat treatments that may have been employed or of adjustments of composition that may have been made to accommodate otherwise damaging heat treatments. Excellent reproducibility between duplicates is normally obtained, except in those instances where the penetration

High and erratic penetration rates were obtained when the testing area inadvertently contained hydrofluoric acid fumes.

rates are quite high. In such cases it is not unusual for duplicate specimens to show marked variation in corrosion rates.

This test has been used in our research laboratories for a number of years, the testing being carried out in a laboratory in which chemical analyses are also made. The heating apparatus used consists of two multiple burner gas-fired hot plates placed side by side so that twenty-four 1000-ml wide mouth Erlenmeyer flasks can be accommodated simultaneously. Each flask is equipped with a finger-type condenser, the cooling water being taken from a manifold-type distributor.

For most types of material the rate of attack follows a similar pattern—the first period rate may sometimes be slightly higher than the second period rate, following which each of the succeeding three periods will have rates as



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NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ Tentative Recommended Practice for Boiling Nitric Acid Test for Corrosion-Resistant Steels (A 262 - 52 T), 1952 Book of ASTM Standards, Part 1, p. 998.

² R. J. Bendure, "Contamination of Nitric Acid as a Source of Error in the Huey Boiling Nitric Acid Test," *Corrosion*, Vol. 10, p. 7 (1954).

TABLE I.—ERRATIC PENETRATION RATES ON TYPE 304 EXTRA LOW CARBON SPECIMENS (RATE = INCHES PER MONTH).

	Period 1	Period 2	Period 3	Period 4	Period 5
A-1	0.0008	0.0016	0.0014	0.0020	0.0054*
A-2	0.0008	0.0050*	0.0013	0.0020	0.0052*
B-1	0.0010	0.0118*	0.0010	0.0013	0.0142*
B-2	0.0042*	0.0007	0.0011	0.0014	0.0025
C-1	0.0061*	0.0009	0.0012	0.0017	0.0028
C-2	0.0020	0.0018	0.0012	0.0018	0.0015
D-1	0.0029*	0.0008	0.0011	0.0012	0.0018
D-2	0.0006	0.0008	0.0011	0.0012	0.0016
E-1	0.0011	0.0007	0.0008	0.0009	0.0013
E-2	0.0007	0.0041*	0.0007	0.0087*	0.0012

* Rate appears to be unusually high.

TABLE II.—EFFECT OF FLUORIDES ON PENETRATION RATES (RATE = INCHES PER MONTH).

	Period 1	Period 2	Period 3	Period 4
A-1	0.0008	0.0008	0.0010	0.0013
A-2	0.0009	0.0009	0.0011	0.0013
A-3	0.0008	0.0008	0.0010	0.0052*
A-4	0.0008	0.0008	0.0010	0.0032*
B-1	0.0006	0.0006	0.0007	0.0009
B-2	0.0006	0.0006	0.0007	0.0010
B-3	0.0006	0.0005	0.0007	0.0086*
B-4	0.0007	0.0005	0.0007	0.0142*
C-1	0.0007	0.0006	0.0006	0.0007
C-2	0.0007	0.0006	0.0006	0.0006
C-3	0.0007	0.0005	0.0005	0.0034*
C-4	0.0007	0.0005	0.0005	0.0036*
D-1	0.0007	0.0007	0.0008	0.0009
D-2	0.0007	0.0007	0.0008	0.0008
D-3	0.0006	0.0006	0.0008	0.0136*
D-4	0.0007	0.0007	0.0008	0.0044*
E-1	0.0006	0.0007	0.0010	0.0012
E-2	0.0007	0.0007	0.0010	0.0014
E-3	0.0007	0.0007	0.0010	0.0075*
E-4	0.0007	0.0007	0.0010	0.0100*

* Samples exposed to fluoride fumes.

high or higher than the preceding period.

From time to time boiling nitric acid corrosion rates were obtained which did not follow the pattern outlined above.² Very high penetration rates would be obtained for one period followed by normal rates for the following period. Where high rates were encountered, the agreement between duplicate specimens was very poor. Repeating the test might or might not result in high and erratic individual period rates. Also, it was noted that when high rates were obtained the test specimens invariably were white and etched, whereas duplicates with normal rates were generally brown and unetched. Table I lists the erratic penetration rates for a group of type 304 extra low carbon specimens

which were heated for 1 hr at 1250 F and water quenched before polishing and testing.

Some of the values are definitely abnormal, as indicated, but some others may also have been affected. For example, duplicate specimens C-1 and C-2 show the same corrosion rate for only the third and fourth periods.

Elimination of possible variables such as surface finish, passivation treatments, etc., did not eliminate occasional erratic rates. Finally, the source of the difficulty was found to be contamination of the nitric acid from an external source.

On occasion, solutions of hydrofluoric and sulfuric acids were evaporated to dryness under one of the hot plates upon which nitric acid tests were being

made. These operations were being carried out by analysts other than those making the nitric acid tests.

To confirm that this was the source of the difficulty, the following experiment was carried out. Quadruplicate specimens from five heats were prepared in the usual manner. Duplicate samples from each heat were then tested on each of the two hot plates. For the first three periods, care was taken that no hydrofluoric and sulfuric acids were evaporated under either hot plate. The resulting penetration rates were normal with good agreement among quadruplicate samples. During the fourth period, however, a mixture of hydrofluoric and sulfuric acids was evaporated beneath one of the two hot plates, and at the same time a high humidity was maintained within the hood by boiling a large container of water. Every sample tested on this hot plate yielded a high penetration rate. The rates for the samples tested on the other hot plate were normal. These results are given in Table II.

Qualitative examination of the nitric acid solution that had yielded high rates showed the presence of an appreciable amount of fluorides. Sulfates were not detected.

The cause of the high rates, therefore, was contamination of the nitric acid by fluorides. When the humidity is high, a considerable amount of moisture condenses on the tops of the finger-type condensers. Fluorides apparently also condensed or were absorbed by moisture on the tops of the condensers and drained into the flasks.

The white etched appearance of the affected samples was caused by the action of the resulting nitric acid-fluoride mixture. Removal of this source of contamination completely eliminated the high and erratic rates.

A somewhat similar situation has been reported by one of our works laboratories. It was found that erratic rates encountered in the boiling nitric acid test were eliminated when the use of hydrogen sulfide was discontinued in an area adjacent to the test flasks.

When other chemical operations are being carried out in the same laboratory in which boiling nitric acid tests are being made, care must be taken to avoid contamination of the acid from external sources.

Stress Relaxation of Vulcanized Rubber in Compression and Tension*

By S. A. Eller

Results obtained on GR-S and butyl stock subjected to room temperature and accelerated aging conditions.

STRESS relaxation is an important consideration in determining the suitability of gasket materials for Navy door hatches, pipe lines, and similar applications. In view of this, the Material Laboratory, New York Naval Shipyard, has devoted considerable time and effort toward the design of equipment to measure stress relaxation of rubber materials deformed in compression and in tension.

Compressive Stress Relaxation Apparatus

A cross-section of the Material Laboratory compression stress relaxation apparatus, drawn to scale except for the 3-in. dimension shown for the height of the bushing support, is shown in Fig. 1. This apparatus is essentially the same as that used to measure the compression set of vulcanized rubber at constant deformation, described in Method B of ASTM Methods D 395.¹ The test specimen, which is a cylinder $\frac{1}{2}$ in. thick by 1.129 in. in diameter, is compressed to the desired deformation between two parallel steel plates. These plates are bolted together to the height of the inserted metal shims, which limit the percentage deformation of the specimen. The part of the top plate assembly that actually compresses the specimen is a load applicator. The load applicator can slide with minimum friction with respect to the top plate and is insulated electrically from the apparatus except for a flange that is in metal-to-metal contact with the underside of the top plate. An electrical resistance meter connected to the ap-

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*The opinions or assertions contained herein are the private ones of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

¹ Tentative Methods of Test for Compression Set of Vulcanized Rubber (D 395-53 T), 1953 Supplement to Book of ASTM Standards, Part 6, p. 1.

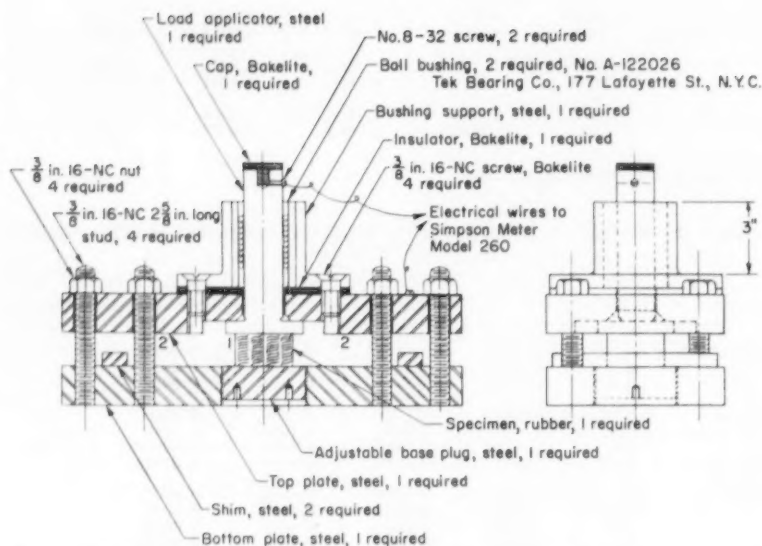


Fig. 1.—Cross-Section of the Material Laboratory Compression Stress Relaxation Apparatus.

paratus measures the resistance at the metal-to-metal contact of these parts.

The arrangement of the apparatus is such that the back stress in the compressed specimen exerts on the load applicator an upward force that is resisted by the top plate. An external force applied to the load applicator decreases the force of the top plate on the load applicator (the sum of these two forces is equal to that exerted by the compressed specimen). The external force, which is increased gradually, causes additional compression of the specimen only when it exceeds the back force in the specimen. When this condition occurs, the additional compression of the specimen results in physical separation of the load applicator from the top plate which is detected on the meter as a change in the contact resistance between these parts. The instant this separation occurs, the force of the top plate on the load applicator is zero, and the back force exerted by the specimen is equal to the external force supplied by the load measuring device. Since the weight of the load applicator itself exerts a force to compress the specimen, its weight is added to the external force reading. The bottom plate of the apparatus has a base plug with a micrometer arrangement so that each division on the underside of the plug corre-

sponds to a relative elevation of 0.001 in. of the plug with respect to the bottom plate. This plug permits accurate adjustment of the percentage of compression of the specimen.

Procedure

In making a test, the height of the specimen is measured. Then the apparatus is adjusted to compress the specimen to the desired deformation. At 3 min \pm 10 sec after the specimen is compressed, the back force exerted by



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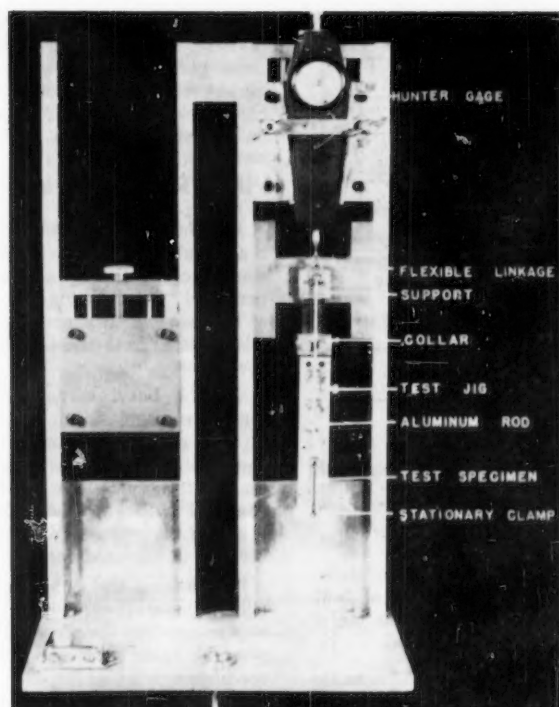


Fig. 2.—Tensile Stress Relaxation Apparatus.

the unaged specimen is determined. The external force is then removed, and the assembled apparatus is allowed to condition for 1 hr at room temperature. At the end of the 1-hr period, the apparatus is subjected to the desired aging conditions. After aging, the back force exerted by the specimen is again determined. Once the stress relaxation apparatus is assembled, no additional manipulation of the specimen is required, regardless of the number of times the back force is measured. This is because only about 0.0005 in. additional compression of the specimen is required to measure the back force. When the aging is done at elevated temperatures, the specimen is allowed to cool at room temperature for $5 \pm \frac{1}{2}$ hr to attain thermal equilibrium.

Tensile Stress Relaxation Apparatus

The tensile stress relaxation apparatus is shown in Fig. 2. This apparatus consists essentially of a removable test jig to maintain a T-50 type specimen at a desired elongation and with provision for measuring the back force in the elongated specimen. The T-50 specimen is elongated between the stationary clamp and a clamp secured to an aluminum rod fitted with a pin that fits into a V-slot in an adjustable collar positioned on the jig. This collar resists the restoring force of the elongated specimen. After assembly, the test jig

is positioned on the apparatus so that the top of the aluminum rod can be secured to a flexible linkage which in turn is connected to a 500-g capacity Hunter spring gage. The Hunter gage is secured to a bracket that can be elevated or lowered relative to the test jig by turning a thumb screw (not shown in Fig. 2).

The arrangement of the apparatus is such that when the Hunter gage is elevated the load on the gage is transferred to the specimen. When this load is less than the back force in the specimen, the rate of load increase on the gage is directly proportional to the movement of the thumb screw, due to the linear relationship between load and elongation of the spring in the gage. However, when this load is greater than the back force in the specimen, the specimen

elongates further. Additional elongation of the specimen is detected visually as a break or discontinuity in the rate of load application with movement of the thumb screw. This test is quite sensitive, and only a slight additional elongation of the specimen is required to obtain a reading of back force. Having measured the back force, the external load due to the Hunter gage is removed. The restoring force of the specimen is then automatically reapplied on the collar. The assembled test jig is then removed from the apparatus and subjected to the required aging conditions. The load reading on the gage, minus the weight of the aluminum rod and the specimen, is equal to the back force exerted by the elongated specimen.

Procedure

In operation, one end of a T-50 specimen is hooked onto the stationary clamp and the other end onto the aluminum rod. The specimen is then elongated within 5 sec to the desired elongation. At $3 \text{ min} \pm 10 \text{ sec}$ after elongation, the back force is determined. The assembled test jig is then removed from the apparatus and permitted to condition for $60 \pm 5 \text{ min}$ at room temperature prior to aging. When the test jig has been aged at elevated temperature, the assembly is allowed to cool for $60 \pm 5 \text{ min}$ at room temperature prior to test. Except for the time spent in obtaining readings of the back force, the assembled test jig was stored and aged in a cellulosic enclosure to minimize ozone effects. This precaution was taken because ozone affects rubber materials more in tension than in compression.

Test Results

For stress relaxation in compression and in tension, the following calculations were made:

$$\text{Back stress, psi} = \frac{\text{back force exerted by specimen}}{\text{cross-sectional area of specimen}}$$

$$\text{Stress relaxation, per cent} = \frac{\text{back stress in unaged specimen} - \text{back stress in aged specimen}}{\text{back stress in unaged specimen}} \times 100$$

TABLE I.—RECIPES AND PHYSICAL PROPERTIES OF RUBBER STOCKS.

GR-S Stock		Butyl Stock	
GR-S	100.0	GR-I	100.0
Zinc oxide	5.0	Zinc oxide	5.0
Phylblack A	40.0	Stearic acid	3.0
Heliozone	1.0	Phylblack A	30.0
Flexol TOF	20.0	Cireo L. P. oil	10.0
Methyl Tuads	0.8	Tuads	1.0
Sulfur	1.0	Captax	0.5
		Polyac	1.0
		Sulfur	2.0
Cure for $\frac{1}{8}$ -in. thickness: 22 min at 310 F		Cure for $\frac{1}{8}$ -in. thickness: 35 min at 310 F	
Tensile strength, psi	1390	Tensile strength, psi	1950
Elongation, per cent	460	Elongation, per cent	585
Hardness, Shore A	45	Hardness, Shore A	40

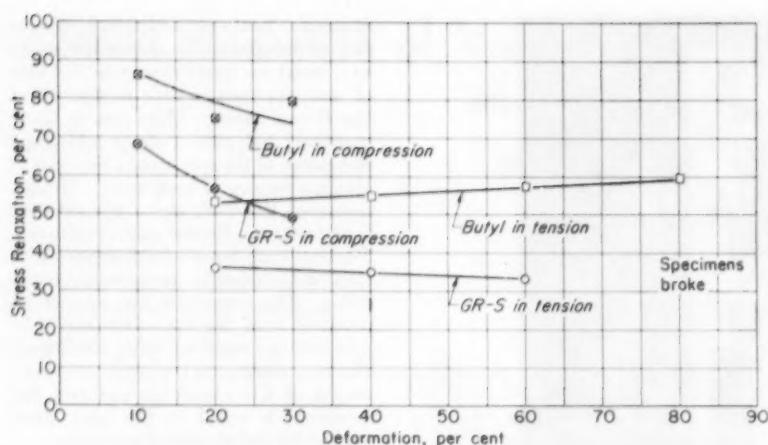


Fig. 3.—Stress Relaxation in Compression and Tension versus Deformation. Specimen Aged for 46 Hr at 194 ± 2 F.

The specimens used for this investigation were a GR-S stock compounded to meet the requirements of Military Specification MIL-R-900A and a butyl stock that was assumed to have high stress relaxation. The recipes and initial physical properties of these stocks are given in Table I.

Tests were made to determine the relationship between stress relaxation in compression and in tension with respect to percentage of deformation. The test specimens, prepared from the GR-S and butyl slabs, were deformed 10, 20, and 30 per cent in compression and 20, 40, 60, and 80 per cent in tension. After the initial back force readings were obtained, the deformed specimens were conditioned for 46 hr at 194 ± 2 F. Following this aging period, the back force in the specimens was again determined. Stress relaxation was calculated and plotted against per cent deformation in Fig. 3.

From Fig. 3 it can be seen that:

1. The stress relaxation in compression of both GR-S and butyl specimens decreased with increase in deformation. Stress relaxation in compression for butyl at 20 per cent deformation was lower than for 10 or 30 per cent deformation. However, additional data are necessary to determine the exact shape of this curve.

2. No significant change in stress relaxation was observed for the GR-S and butyl specimens tested in tension.

3. The GR-S specimens subjected to 80 per cent elongation broke prior to removal from the oven. This failure may have been due to stress concentration at the shoulders of the T-50 specimen.

4. At the same percentage of deformation, the stress relaxation of both GR-S and butyl specimens was higher in compression than in tension.

Tests were also made to determine the relationship between stress relaxation in compression and in tension with respect to continuous aging at room and elevated temperatures. The test specimens, prepared from the GR-S and butyl slabs, were deformed 20 per cent in compression and 40 per cent in tension. The back force was measured and the specimens aged at room temperature. Additional specimens, similarly deformed, were conditioned at 194 ± 2 F. At selected intervals of time up to a conditioning period of about 2 weeks, the back force in the specimens

was determined. The conditioning time at 194 ± 2 F was calculated omitting those periods of time when the specimens were cooling to room temperature. Stress relaxation of the specimens was calculated and plotted against conditioning time in Fig. 4.

From Fig. 4 it can be seen that:

1. The stress relaxation of both GR-S and butyl in compression and in tension increased with aging time and temperature. Conditioning the specimens at 194 ± 2 F greatly increased the stress relaxation of both the GR-S and butyl specimens.

2. The butyl specimens exhibited higher stress relaxation at 194 ± 2 F in both compression and tension than the GR-S specimens, whereas at room temperature the reverse was true. The Material Laboratory is unable to give a reason, at present, for this apparent reversal in expected results.

3. Plotting the data on semilogarithmic paper appears to be a convenient way to correlate the effects of room temperature aging with accelerated aging conditions.

Acknowledgment:

The author wishes to express sincere thanks to C. K. Chatten of the Material Laboratory for his extremely valuable guidance and cooperation in the preparation of this paper.

The author also wishes to thank J. Z. Lichtman and G. Adler of the Material Laboratory, the designers of the tensile stress relaxation apparatus, for the use of this apparatus in the investigation.

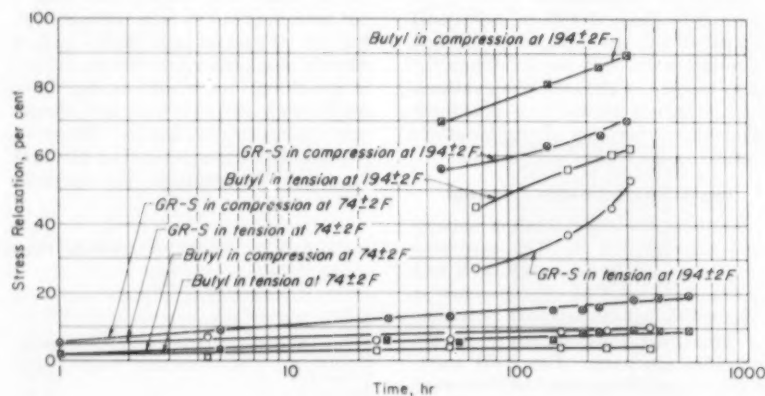


Fig. 4.—Stress Relaxation in Compression and Tension versus Time. Specimen subjected to continuous aging at room temperature and at 194 ± 2 F. Compression tests conducted at 20 per cent deformation, tension tests at 40 per cent deformation.

[See Joint Discussion, page 85, TP 157]

Stress Relaxation of Nonmetallic Gasket Materials*

By David R. Lem and John M. Reynar

THIS paper deals with test equipment, test procedure, and results of tests on all types of non-metallic gasket materials. Although it is presented by automotive engineers as users of purchased stock, an objective viewpoint has been attempted so that controversial issues or specific

A functional test fixture, a testing procedure, and a formula by which numeric values can be obtained for per cent stress relaxation for all types of nonmetallic gasket materials.

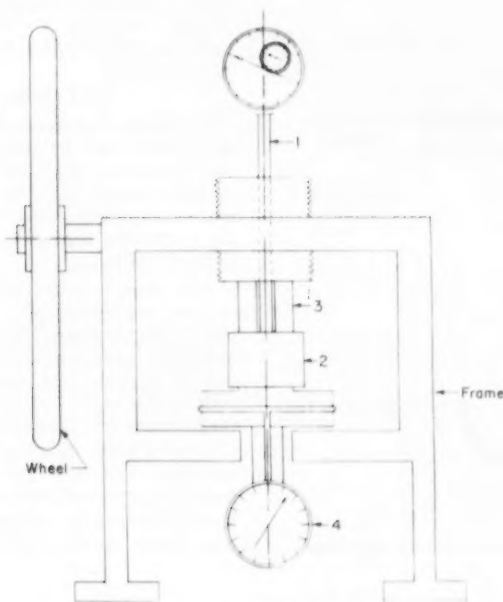


Fig. 1.—Farnam-Cole Relaxometer.

equipment may not take inordinate proportions in dealing with an issue that can develop to the great benefit of both producers and consumers. The automotive industry has grown so rapidly that many of its terms have been borrowed from older trades and industries. As a result, new definitions are needed; and acceptable testing procedures are required for obtaining exact values for physical properties of interest. In the automotive industry, gaskets are sheets of com-

pressible materials cut to an exact design to fit between rigid, static, flange faces to prevent leakage of fluid particles that are to be contained in, or ex-

cluded from, a finite system. *Packings* to the automotive engineer are shaped or shapable strips, rovings, or rings that are used as static or dynamic seals in recessed cavities packed, by tamping or by compression under a loading gland, to seal more rigid members. *Sealers* are mastic compositions that dry or remain mobile, as required, and are used to seal threaded or flanged joints to prevent leakage in a static system. *Seals* are shaped components that are designed, fabricated, or molded to accomplish a desired sealing function. They usually retain fluids against rotating or reciprocating shafts. Descriptive adjectives usually define their type, usage, or shape: for example, spring loaded lip-type oil seals; face-type closures; "O" rings; or dynamic fluid seals.

Gasket materials are usually marketed as thin sheets, the nonmetallic varieties being cut to special shapes by means of steel rule dies.

The two most important requirements of gaskets are: (1) ability to seal and (2) ability to maintain the seal for finite periods of time. It is to the second of these requirements that stress relaxation pertains. Such relaxation in metals is referred to as creep, in nonmetals as stress decay, and to the mechanic who has to tighten the nuts on the bolts or studs that exert force upon a gasket, as loss in torque retention.

Detroit Arsenal has had close association with Section X on Automotive Gaskets of the Joint SAE-ASTM Committee on Automotive Rubber. Consequently there was issued the Ordnance Specification MIL-G-12803 for *Gasket Materials, Nonmetallic* which corresponds to specifications SAE-90R and

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* This paper was presented at a meeting of Subcommittee X on Physical Testing of Rubber Products, of ASTM Committee D-11 on Rubber and Rubber-like Materials, February 4, 1954, Cincinnati, Ohio.

¹ Tentative Method of Test for Compressibility and Recovery of Gasket Materials (D 1147 - 53 T), 1953 Supplement to Book of ASTM Standards, Part 6, p. 56.



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ASTM D 1147.¹ The absence of values for a physical property so important as stress relaxation was regarded as a deficiency of these specifications. As a step toward the correction of this deficiency and as a contribution to the efforts of the Gasket Subcommittee, Contract DA-20-089-ORD-36608 was negotiated with the University of Detroit to make an engineering survey of all existing methods of measuring stress relaxation, to select the simplest and most accurate equipment, and to determine values for all types of nonmetallic gasket materials by a procedure that could be used in technical laboratories. The work was competently executed by L. S. Kowalczyk of the Chemical Engineering Department.

Test Equipment

The instrument, Fig. 1, used in this study was the Farnam-Cole Relaxometer.² In line with the service usage of gaskets, it is a compression apparatus, fixed load, continuous stress reading type. Its main part is a small capsule, Fig. 2, in which a die-cut gasket specimen, *D*, fits between perfectly plane and accurately registered ring faces, *B* and *C*, of 1 sq in. compression area, and with a $\frac{1}{4}$ -in. diameter hole. Figure 3 shows the anvil on which the capsule is mounted—first unloaded, then loaded—subtended by the hy-

² This instrument, Type RT, Model D, is manufactured by the Cole Electric Co., 125 Prairie St., Park Ridge, Ill.

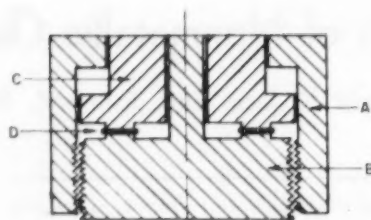


Fig. 2.—Cross-Section of Capsule.

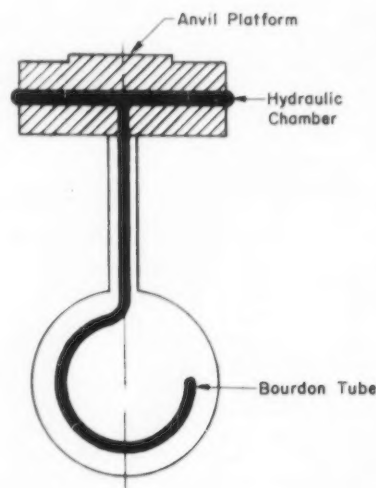


Fig. 3.—Hydraulic System and Gage.

draulic system involving a bronze bellows and a Bourdon gage. Figure 1 shows the capsule, 2, on the anvil, which measures the force, and the stress column, 3, which transmits the force from an external handwheel through a worm wheel to the ring faces inside the capsule. Preload is applied by weight of *C* (Fig. 2), and by added stress from handwheel through worm and hollow internal gear. Thickness readings are made by means of a rod and tube dial gage, 1, Federal Model E 3 BS-2, that can be read to 0.0001 in. and estimated to 0.00001 in.; and loading stresses are read from pressure gage, 4, actuated by a Bourdon tube directly connected to hydraulic platform on which anvil is supported.

Test Procedure

Specimens of gasket materials are cut, by a steel rule or punching die, to washers that overlap the capsule ring surfaces about $\frac{1}{8}$ in. on both inside and outside diameters. Preconditioning is done in accordance with standardized conditions.

The capsule parts and contacting surfaces are first cleaned with alcohol; then with specimen in position the assembled capsule is brought to equilibrium at appropriate temperature for making the test. It is important that the instrument frame be rigidly mounted to a stable platform within the thermostatically controlled housing. Thickness of the specimen is taken as the difference between the readings of the top linear gage on the unloaded capsule

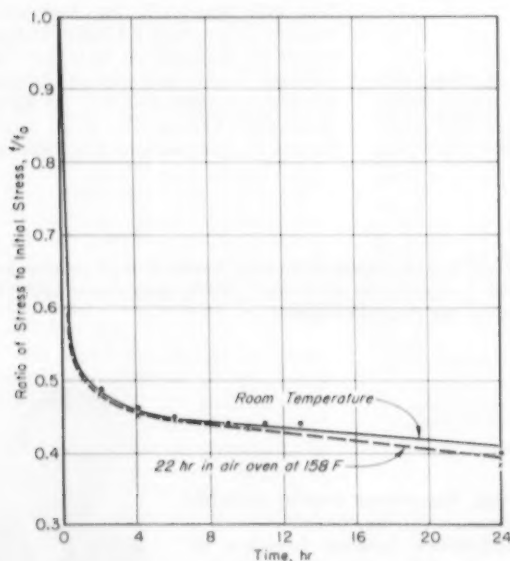


Fig. 4.—G-1111 RS Rubber-Asbestos.

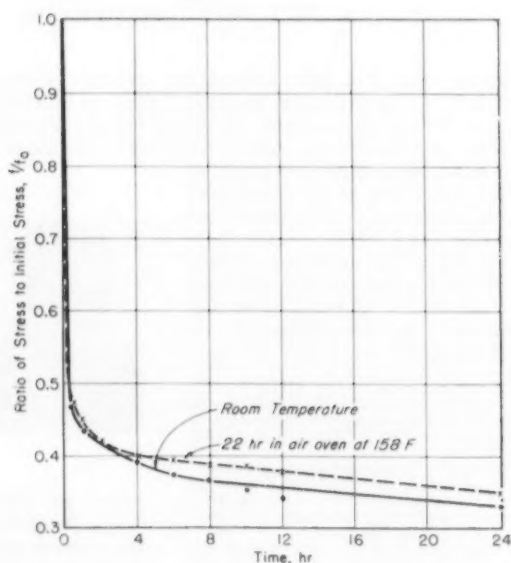


Fig. 5.—G-1211-3 RS Rubber-Cork.

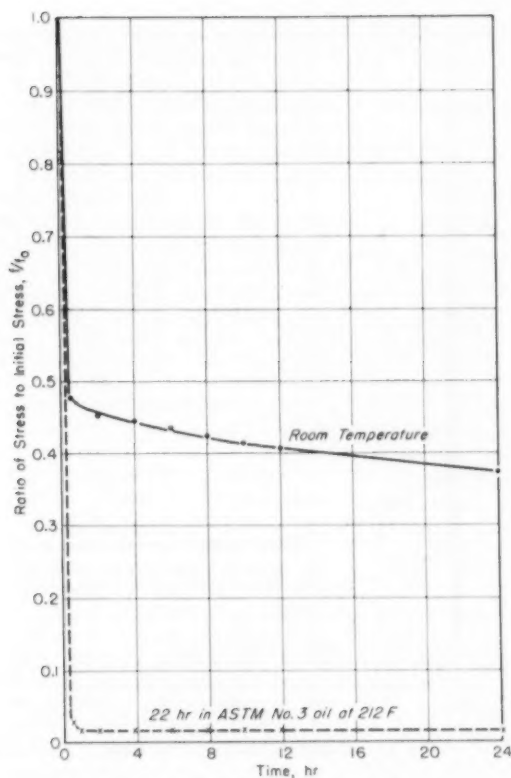


Fig. 6.—G-1122 SB Rubber-Asbestos.

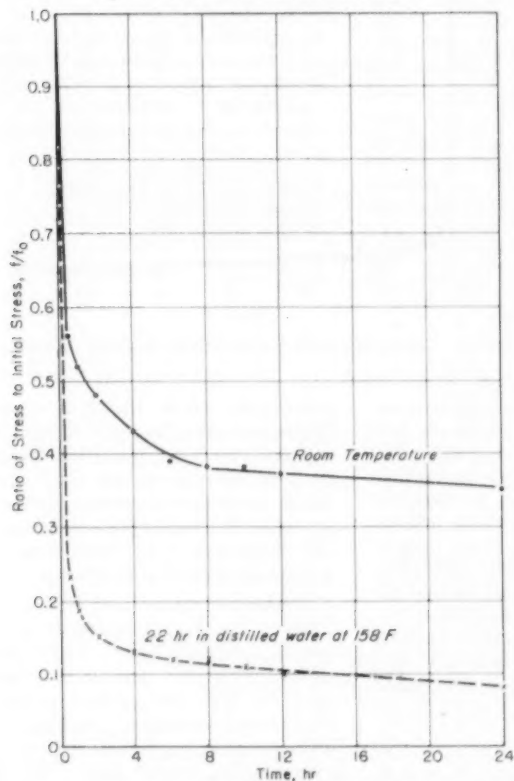


Fig. 7.—G-2212 Resin Bound Cork.

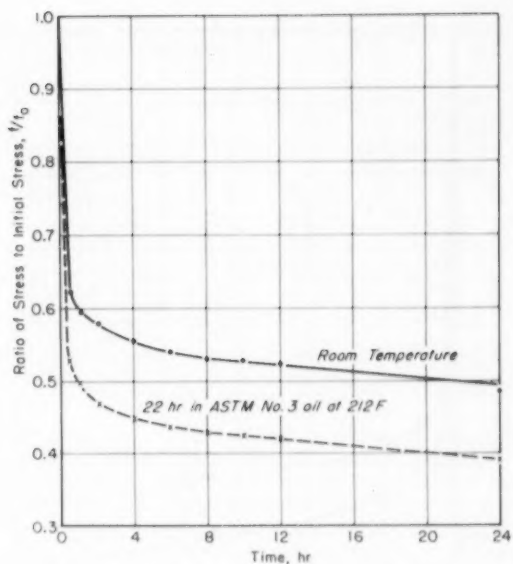


Fig. 8.—G-1222-2 SB Rubber-Cork.

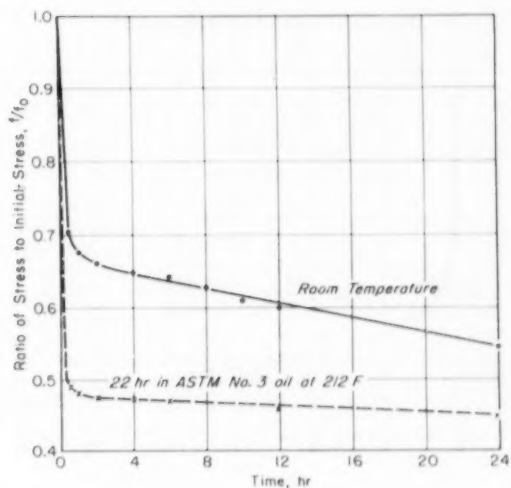


Fig. 9.—G-1423-3 SC Rubber-Fiber.

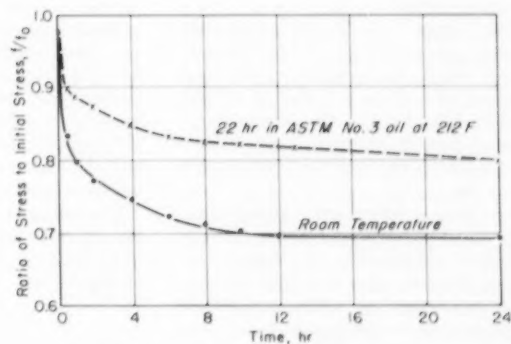


Fig. 10.—G-3111 Manila Tag Paper.

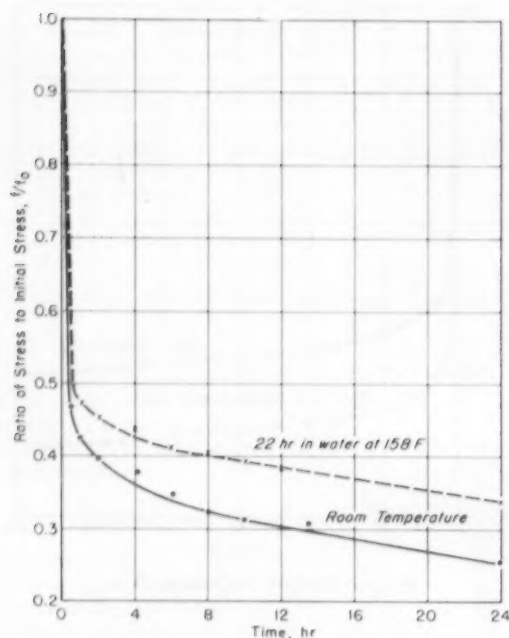


Fig. 11.—G-3233-2 SC Rubber-Fiber.

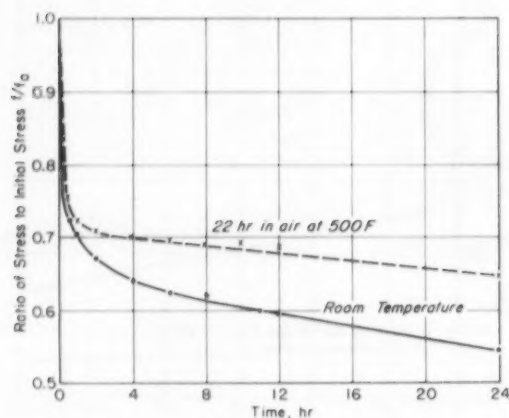


Fig. 12.—G-4111 Asbestos Fiber Paper.

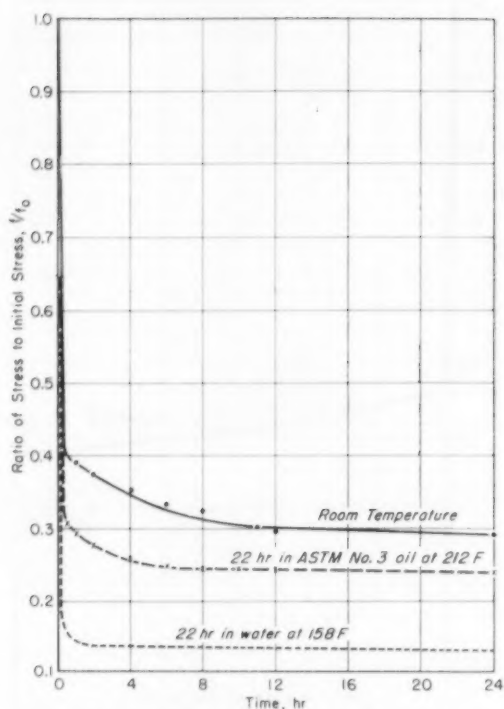


Fig. 13.—G-3212 Glue-Glycerine Paper.

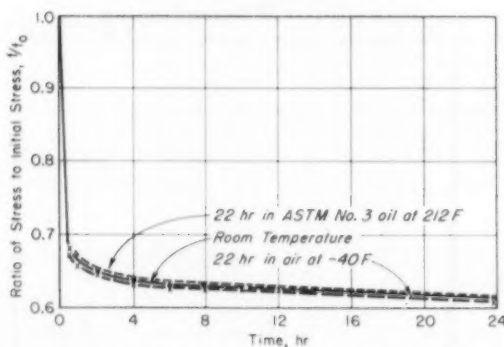


Fig. 14.—Grade SB420AB, Oil Resistant, Synthetic Rubber.

and on the capsule with specimen under specified preload.

The major load is now uniformly applied, being fully exerted in 10 sec \pm 1 sec. Major loads in this work were identical with those specified in ASTM Method D 1147.¹ (It was recommended that compressed asbestos sheet have preload reduced to 1000 lb for better results.)

Zero time is taken as the point when major load is reached. Relaxation is permitted immediately; the next stress reading is taken after 1 min and subsequent readings just often enough to describe a smooth curve.

Thickness under the major load, which also gives the compressibility

of the gasket, is taken immediately upon arrival at the specified value on the pressure gage and at the end of the 10-sec time specified. (An extra washer or two may be required to gain experience in rate of cranking and in reading precisely the linear gage.) Throughout the test this thickness at the end of 10 sec is adjusted and maintained constant by the external handwheel.

Temperature must remain constant throughout the test; therefore, the glass door of the closure must remain closed.

Test Results

Relaxation in all nonmetallic gasket materials shows the greatest drop in

push back within the first minute. Subsequent relaxation is at a diminishing rate. In the curves, Figs. 4 to 14, the ratio of stress at any time to the initial stress at the 10-sec point is shown on the Y-axis. These ordinates are designated f/f_0 . Time intervals in hours are shown on the X-axis.

Relaxation curves vary widely for different families of materials but a certain similarity exists within each family. It is very possible that equations for the ideal gaskets of resin-bound cork granules, rubber-bound cork granules, impregnated paper, or compressed asbestos sheet may be written. Products may eventually be

qualified by proximity of their stress relaxation values to an ideal curve.

Curves illustrating the stress relaxation and effect of preconditioning for all types of nonmetallic gasket materials as measured by L. S. Kowalczyk on the Farnam-Cole Relaxometer are shown in Figs. 4 to 14.

Figures 4 and 5 show that preconditioning the specimens had no appreciable effect on stress relaxation, while Figs. 6 and 7 show that preconditioning greatly degraded the gasket. Slight degradation resulted from preconditioning the specimen shown in Fig. 8. Preconditioning stabilized the material shown in Fig. 9, and a definite improvement of stress relaxation resulted from preconditioning the specimens shown in Figs. 10, 11, and 12. Values for G-3212 glue-glycerine sheet paper after pretreatments in air, oil, and water show, in Fig. 13, that relaxation diminishes for gaskets treated by these media in that order. Figure 14 shows stress relaxation values of a sheet of oil-resistant synthetic rubber, Grade SB420AB, compounded to a compression set value of 15 per cent. Pretreatment in air at -40 F, at room temperature, or in ASTM No. 3 oil 22 hr at 212 F, shows no variation in stress relaxation.

It is recognized that a single numerical value for stress relaxation of a gasket material would be desirable for inserting in a table as a property of a material. Along with other properties such as compressibility, temperature resistance, permeability, etc., tabular data within reasonable limits would greatly improve our specifications. Improved specifications mean better engineered products and assurance of quality from supplier to consumer.

Since relaxation rate has usually

TABLE I.—VALUES FOR STRESS RELAXATION OF NONMETALLIC GASKET MATERIALS.

Identification	Material	Major Load, psi	Stress Relaxation, per cent
G-2212	Cork-Resin	100.	61.0
G-2112	Cork-gelatin	100	60.0
(SB420AB)	Rubber	200	29.5
G-1211-3	Cork in rubber	400	62.5
G-1222-2	Cork in rubber	400	46.0
G-3212	Fiber resin	1000	66.5
G-3233-2	Fiber rubber	1000	65.0
G-4111	Asbestos paper	1000	37.5
G-1423-3	Fiber rubber	1000	36.0
G-1323-1	Rubber-cork-fiber	1000	35.0
G-3262	Fiber SB coated	1000	35.0
G-3111	Paper, tag	1000	27.5
G-1122	Rubber-asbestos	2000	56.5
G-1111	Rubber-asbestos	2000	45.3

flattened off in about 6 hr, it is suggested that torque loss for gasket materials be expressed as Percentage Stress Relaxation. This is given by the formula:

$$\text{Per cent stress relaxation} = \left(1 - \frac{f}{f_0}\right) 100$$

where:

f_0 = the initial stress under major load, and
 f = residual stress after 6 hr.

Values for representative materials based upon this formula are shown in Table I.

Conclusions

The Farnam-Cole Relaxometer is not the ultimate in what is required in such instruments: the hydraulic system tends to leak; the gages are whimsical; extreme care in reading gages accurately, exact timing, and precise manipulations are required for exact and reproducible values.

The Farnam-Cole Relaxometer, Type RT, Model D, is currently adequate

for qualification testing of all varieties of nonmetallic gasket materials. A testing procedure and a formula have been presented for accurately determining a very important property of gasket materials—percentage stress relaxation. Curves have been presented to illustrate stress relaxation in all types of commercial gasket materials from very soft cork products to very hard compressed asbestos sheet. This important physical property has been reduced to a numerical value for insertion into tables of data.

Since it is the function of the American Society for Testing Materials to standardize testing procedures and to set values for physical properties of all commercial materials, it is the recommendation of the authors that a tentative standard be set up for the measurement of percentage stress relaxation of nonmetallic gasket materials by means of the compression capsule described, the procedure and formula presented, and a fixed load-continuous stress reading instrument that can yield results as good or better than these presented.

JOINT DISCUSSION OF PAPERS BY S. A. ELLER AND BY D. R. LEM AND J. M. REYNAR

MR. F. C. THORN.¹—We have had described two excellent relaxation methods and it is not my intention at this time to offer a third method. I have, however, permitted myself the luxury of visualizing a third method which would combine the advantages of these

two. I show the essential features of the methods in parallel columns below. The first thing we have to decide is whether this is a research tool or a method for buyer-seller acceptance.

¹ Research Director, The Garlock Packing Co., Palmyra, N. Y.

If it is a method for buyer-seller acceptance, we have to visualize a situation where it is used with about the same intensity as the present compression set test. In a large laboratory this can mean as many as twenty tests starting every night. It would obviously be impractical to have twenty relaxometers; therefore, the answer lies in a removable jig. The original Hopkins-Farnam jig was intended for multiple use. I like to call it "Hopkins-Farnam jig" because it employs the original Hopkins principle of measuring load by the initiation of recompression. The Navy jig is also of the Hopkins type and intended for multiple use. There-

	Relaxometer Room Temperature Only	Hopkins-Farnam High Temperature (Test Cold)	Navy Jig High Temperature (Test Cold)	Wanted High Temperature (Test Cold)
Tests per machine in 24 hr.	1	Up to 20	Up to 20	Up to 20
Determining point of recompression.	None required	Dial gage	Electrical	Electrical
Pre-determined.	Stress	Stress or strain	Strain	Stress or strain

fore, I have indicated a jig procedure as desirable.

The second question is whether relaxation at room temperature is an index of relaxation at service temperature. We have ample evidence that it not only gives much lower values but does not even rank materials in the same sequence as tests at elevated temperatures. Furthermore, relaxations at elevated temperatures involve the factor of thermal contraction on recooling which is completely absent in tests run at room temperature. I have, therefore, shown testing at service temperature as an essential factor in any final procedure. This again necessitates the jig.

Assuming the jig, the next question has to do with the method for signaling the inauguration of recompression in accordance with the Hopkins procedure. There are three methods which I will designate respectively as dial gage, friction, and electrical. The dial gage was intended for use with the Hopkins-Farnam jig. I agree with Kowalczyk that it is not sufficiently sensitive to give reproducible results. To get reproducible results it is necessary to duplicate original strain to ± 0.0001 in. The dial gage will not do this. About a year ago I demonstrated that the Hopkins-Farnam jig could be made to yield a sensitive signal by friction—by exerting a steady torque on the recoil collar and observing the instant of slipping. This method obviously is full of variables and I am not disposed to stress it. The Navy method employs the principle of electrical break, which is seen to be reproducible and free from personal factor. I have, therefore, indicated an electrical signal as desirable.

The fourth question has to do with whether the sample is compressed originally to a predetermined strain or predetermined stress. The Navy jig is designed only for predetermined strain. This is understandable in view of their preoccupation with bulkhead gaskets which are fastened by locking dogs having a limited throw. For commercial gasketing the greatest interest lies in a predetermined stress, as governed by a bolt circle containing a fixed number of bolts of a given size and tightened with a given torque. There are some applications involving a mechanical stop where the interest lies in a predetermined strain. The original Hopkins-Farnam jig is designed primarily to be locked under a predetermined stress, but may be converted to predetermined strain by including a spacer ring with the sample. I have indicated optional predetermined stress or strain for the desired instrument.

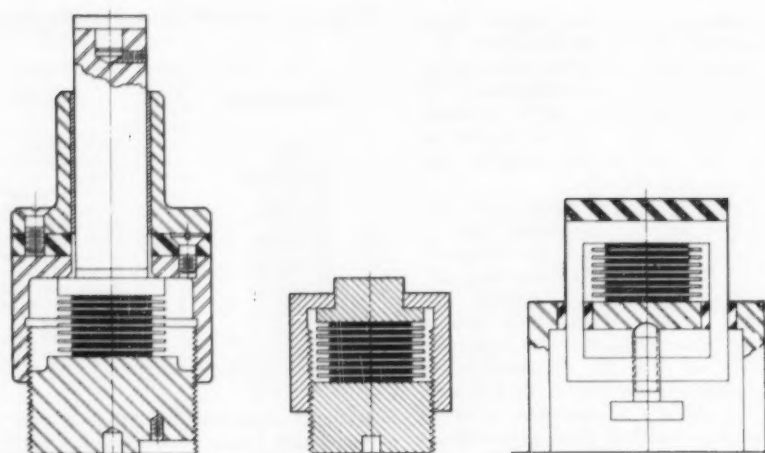


Fig. 15.—Original Hopkins-Farnam Jig with Two Modifications.

In the accompanying Fig. 15 is shown the original Hopkins-Farnam jig with two modifications designed to bring it in accordance with the desired type. The original jig is shown in the center in the form of one of its numerous modifications. This particular modification was made with unrestricted platen areas, and made deep to accommodate a stacked specimen with separators. This subdivides the errors which result from trying to measure the strain within a single specimen.

An electrical signal in the presence of an annular recoil collar necessitates complete parallelism between collar and upper platen so that the electrical break is sharp and not blurred. The Navy accomplishes this by careful guidance of the upper platen within the recoil plate. In the left-hand modification the recoil collar was deepened and equipped with a close fitting bronze bushing. Unfortunately the electrical signal was not sharp but blurred. Accordingly the results have been poor. On $\frac{1}{8}$ -in. red sheet disks stacked eight high, I have obtained 22 hr relaxations of 19 per cent, 24.5 per cent, and 15 per cent.

This represents not only bad checking but the figures are all too low. The true figure should be about 35 per cent. In 22 hr at 212 F I obtained two successive readings of 100 per cent relaxation. This is probably too high. Obviously the new jig is also full of variables.

The right-hand view is diagrammatic and represents an instrument now on the drawing board and designed to

overcome the faults of the second jig. In this the need for extreme parallelism of upper platen and recoil collar has been avoided by reducing the recoil device to a simple screw located in the neutral axis. I hope to have some data to report on this jig in June. In the meantime I will send detailed prints of the third jig to anyone who would like to experiment with it.

MR. S. A. ELLER (*author's closure*).—The author wishes to thank Mr. Thorn for his comments and his numerous contributions to measurement of stress relaxation of gasket materials.

According to Mr. Thorn, the Navy jig (Material Laboratory Compression Stress Relaxation Apparatus) conforms to the desired essential features of a satisfactory stress relaxation apparatus, except that the specimen is compressed to a predetermined strain instead of an optional predetermined stress or strain. This condition arises because the Navy jig was designed primarily to investigate stress relaxation of bulkhead gaskets which in service are compressed to a predetermined strain.

However, the Navy jig may also be used to determine stress relaxation of gasket materials compressed (at constant strain) to a predetermined stress. To do this, the stress-strain curve of the gasket material under test must first be determined. The jig is then adjusted to compress the specimen to a deformation (at constant strain) which corresponds to the desired predetermined stress. Thereafter the procedure remains the same as previously described.

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

At the 11th Annual Meeting of the Metal Powder Assn. in Philadelphia in May, **Morris Boorky**, President of the Presmet Corp., Worcester, Mass., was elected President of the Association. **B. T. du Pont**, Sales Manager, Plastic Metals Division of National-U. S. Radiator Corp., Johnstown, Pa., was elected Chairman of the Board. **W. A. Irvine**, Manager, Production Engineering, Maytag Co., Newton, Ia., and **Carl Johnson**, Vice-President, Presmet Corp., are members of the Board.

Among United States Delegates to the International Electrotechnical Commission meetings in London, June 28-July 9, were the following ASTM members: **J. H. Foote**, President, Commonwealth Associates, Inc., Jackson, Mich.; **V. M. Graham**, Associate Director, Engineering Dept., Radio-Electronics-Television Manufacturers Assn.; **Herman Halperin**, Assistant Equipment and Research Engineer, Commonwealth Edison Co., Chicago, Ill.; and **E. F. Seaman**, U. S. Department of the Navy, Bureau of Ships, Washington, D. C.

Joseph G. Althouse has been appointed Chief Metallurgical Engineer, Lukens Steel Co., Coatesville, Pa.; and **H. A. Grubb**, Metallurgical Plant Engineer.

Othmar H. Ammann, bridge designer and senior partner in the New York City consulting firm of Ammann & Whitney, received the 1955 Citizen and Engineering Award of the New Jersey Society of Professional Engineers at the Society's thirty-first annual convention in Newark in April.

Fred W. Argue, formerly Engineering Manager, has been elected a Vice-President of Stone & Webster Engineering Corp., Boston, Mass.

E. L. Baldeschwieler, who recently retired as Section Head, Products Research Division, Esso Research and Engineering Co., received an American Petroleum Institute Certificate of Appreciation, recognizing his part in advancing the role of analytical chemistry in petroleum technology.

L. J. Barker has been made Chief Specification Engineer, Kaiser Aluminum and Chemical Corp., Oakland, Calif.

B. J. Barmack is retiring as Senior Engineer, Transmission Engineering Dept., Commonwealth Edison Co., Chicago, Ill.,

after almost 39 years with the company. Mr. Barmack plans to continue in ASTM technical committee work. He has been especially active in Committee A-5 on Corrosion of Iron and Steel, serving as Chairman of the Subcommittee on Hardware Specifications for the past ten years. (See page 16 for news of Mr. Barmack's receipt of a 1955 ASTM Award of Merit.)

Fred B. Behrens, until recently with the Wilshire Oil Co., Inc., Norwalk, Calif., has joined Richfield Oil Corp., as Assistant to the Vice-President.

Frederic Benard has been appointed Assistant to the Vice-President, The International Nickel Co. of Canada, Ltd., Copper Cliff, Ontario.

John W. Bennett, Chief Engineer, Western Massachusetts Electric Co., Springfield, has been transferred to the grade of Fellow in AIEE "for his contributions to the design and construction of electric distribution and generating systems."

John H. Berglund's paper "Automatic Equipment for Measuring Liquid Levels and Temperatures of the Contents of Oil Storage Tanks" appears in the recently published proceedings of the International Technical Economic Congress held in Antwerp, Belgium, to celebrate the silver jubilee of the Royal Flemish Engineers Assn. Mr. Berglund, a research chemist with the Products Research Division, Esso Research and Engineering Co., Linden, N. J., was awarded a medal for his presentation by the Royal Flemish Engineers. He has made many contributions to the work of measurement committees in both ASTM and the API.

Rubin Bernstein, formerly Head, Detergent Group, Philadelphia Naval Shipyard, Industrial Test Laboratory, has joined Clarkson Laboratories, Philadelphia, as Director of Research and Development.

Robert F. Blanks, Vice-President and General Manager, Great Western Aggregates, Inc., Denver, has been elected President of the Colorado Society of Engineers.

Malcolm C. Boisselier, formerly Assistant Sales Manager, has been elected Vice-President-Sales, Texas Steel Co., Fort Worth, Tex.

George C. Brooks, formerly with the

Freebrook Corp., Kittanning, Pa., is now Flotation Mill Supervisor, Phosphate Mining, Armour Co., Lakeland, Fla.

George Granger Brown, Dean of Engineering at the University of Michigan, received the honorary degree of Doctor of Engineering from the New York University College of Engineering at the recent centennial convocation.

Kenneth R. Brown, owner, Brown Engineering Co., Des Moines, Iowa, has been transferred to the grade of Fellow in the American Institute of Electrical Engineers "for contributions to the development and technical integration of electric utilities and to protection of transformers on rural systems."

Guy H. Burrell, President, Burrell Corp., Pittsburgh manufacturers of laboratory instruments and supplies for the scientific field, has been named section chairman of the Scientific Apparatus Makers Assn.

California Testing Laboratories, Inc., Los Angeles, Calif., recently acquired California Electronic Services, Woodland Hills, Calif., becoming with this addition one of the most completely integrated independent laboratories in the West, serving as an environmental and qualification testing source for industry and the military. The organization continues its service in the chemical, metallurgical, petroleum and construction fields. **Myron Niesley**, President of CTL, is Chairman of the ASTM Southern California District Council.

Byron F. Campbell, formerly Executive Engineer, Massey-Harris-Ferguson, Inc., Detroit, Mich., has been appointed Vice-President and Director of Engineering of Allen Electric and Equipment Co., Kalamazoo, Mich. His appointment is in line with the company's plan for further expansion in the automotive electrical testing equipment field.

Past-President **Arthur W. Carpenter** has retired as Manager of Testing Labs., The B. F. Goodrich Co., Akron, Ohio, after many years of service with the company. An outstanding authority in the rubber field, Mr. Carpenter has been Secretary of Committee D-11 on Rubber and Rubber-Like Materials since 1928. See page 13 for news of his recent election to ASTM Honorary Membership.)

P. E. Cavanagh has been named Director, Department of Engineering and Metallurgy, Ontario Research Foundation, Toronto, Canada, succeeding **G. W. Ellis**, who recently retired.

Robert D. Coghill, Director of Research, Abbott Laboratories, North Chicago, Ill., became Vice-President, President-elect, and a Director of the Industrial Research Institute, Inc., at the Institute's annual meeting in May.

William A. Cordon, formerly with the U. S. Bureau of Reclamation, Denver, Colo., is now Research Engineer, Portland Cement Assn., Chicago, Ill.

John S. Davey was promoted to Vice-President of Russell, Burdall & Ward Bolt and Nut Co., Port Chester, N. Y.

Harold J. Dawe, Director of Research, Acheson Colloids Co., Port Huron, Mich., and a national authority on colloidal graphite and solid lubricants, was the featured speaker on the subject "Characteristics and Performance of Solid Lubricants" at a dinner meeting of the Chicago Section, American Society of Lubrication Engineers, in April. Dr. Dawe is Chairman of Research Division XII on Graphite Tests of ASTM Committee D-2 on Petroleum Products and Lubricants.

R. Robertson Deans has retired as President of Canadian Inspection & Testing Co. Ltd., Toronto. He had been associated with the company for 37 years. Mr. Deans is one of the 1955 ASTM Forty-Year Members.

Paul L. DeVerter, Head of Inspection Laboratory, Humble Oil & Refining Co., Baytown, Tex., refinery, received a "Citation for Service" from the American Petroleum Inst., based on outstanding service to the Institute's program on measuring, sampling, and testing natural gas and natural gasoline; and in the development of accurate means of calibrating and gaging spherical and spheroidal tanks.

Ray P. Dinsmore, Vice-President in Charge of Research and Development, Goodyear Tire and Rubber Co., Akron, Ohio, and recently elected President of the American Institute of Chemists, has been chosen by the Rubber Division of the American Chemical Society to receive the Charles Goodyear Medal for 1955. The medal is given in commemoration of the discoverer of vulcanization of rubber to someone who has made a valuable contribution to the science or technology of rubber or related subjects.

Robert F. Duncan has been elected to the newly created position of Executive Vice-President, Calumet Refining Co., Chicago, Ill. Mr. Duncan has been Secretary and Treasurer and a member of the Board of Directors of his company since 1950. He continues to serve as Treasurer.

B. E. Ely, formerly product specialist on "Teflon" (polytetrafluoroethylene) with the Polychemicals Dept., E. I. du Pont de Nemours and Co., Inc., now heads the production department of a new company—Pennsylvania Fluoro Plastics Co., Philadelphia, established to produce thin and heavy walled "Teflon" tubing for application in the electrical, chemical, petroleum, and aircraft fields. Mr. Ely has been active in ASTM Committee D-9 on Electrical Insulating Materials, being former secretary of this group.

Herman C. Fischer, formerly Assistant Professor, Massachusetts Institute of Technology, Cambridge, is now Research Chemist, Waseco Chemical Co., Sanford, Me.

Sheldon E. Fitterer, formerly a member of ASTM staff, is now associated with

North American Aviation, Inc., Propulsion Center, Los Angeles, Calif., as Service Analyst and Rewrite Editor.

Joseph C. Fox, long associated with Doehler-Jarvis Corp. as Chief Metallurgist, has opened his own office at 4401 Jackman Rd., Toledo, Ohio, for consultation on matters pertaining to the chemical and metallurgical phases of the die casting process.

William Robert Franklin has accepted a position as Chief Engineer, Daniel Construction Co. of Virginia, Richmond, Va.

William Howlett Gardner, previously with the New Products Division, National Aniline Division, Allied Chemical & Dye Corp., New York City, is now attached to the Chemical Sales Department of that company. In his new position, Dr. Gardner will be responsible for the preparation of technical literature on National's new chemicals which include adipic acid, caprolactam monomer, isocyanates, and other organics. Additionally he will act as a technical representative in the sale and application of National Aniline chemicals.

Werner F. Goepfert has been appointed Manager of Technical Services Dept., International Div., Interchemical Corp., New York City.

Harvard H. Gorrie, until recently Chief Engineer, has been elected Vice-President in Charge of Engineering, Bailey Meter Co., Cleveland, Ohio. Mr. Gorrie has been with the company since 1927. In ASTM he is currently serving on the Cleveland District Council.

F. R. Grant, formerly Chemical Engineer, Cooperative Farm Chemicals Assn., Lawrence, Kans., is now Project Manager, George Armistead and Co., Washington, D. C. At present he is in Athens, Greece, on a company project.

Robert Donald Grant has accepted a position with the Boyle Engineering Co., Santa Ana, Calif. Previously he had been associated with the Arabian American Oil Co., Dhahran, Saudi Arabia, as Materials Testing Engineer.

William H. Graves, Vice-President of Engineering, Studebaker-Packard Corp., Detroit, Mich., was elected Secretary of The Engineering Society of Detroit. A long-time ASTM member and former Director, Mr. Graves also is a Past Officer and Honorary Member of the ASTM Detroit District Council.

Samuel S. Gutkin has been named Sales Manager for resins and specialties in the Eastern areas serviced by the Philadelphia plant of Cargill, Inc. He also will remain in charge of resin product development and Technical Sales Services in this area.

Childress B. Gwyn, Jr., formerly Chief Engineer and General Manager, Tungsten and Sintered Metals Div., The H. A. Wilson Co., Union, N. J., is now Technical Adviser, Engineering and Sales Dept.,

General Plate Division, Metals and Controls Corp., Attleboro, Mass.

Edward E. Hall has been appointed Technical Director—Tool Steels, Universal-Cyclops Steel Corp., Bridgeville, Pa. He was formerly Chief Metallurgist at the firm's Titusville, Pa., plant.

Richard E. Heartz, of Montreal, took office in May as President of the Engineering Institute of Canada. Long active in Institute affairs, Mr. Heartz has been successively member of the council, treasurer, and chairman of the Montreal branch. A 1917 graduate of McGill University, he has served the Shawinigan Engineering Co., Ltd., and its parent, the Shawinigan Water and Power Co. since 1920; he became Vice-President and Chief Engineer in 1947 and has been President since 1952. Mr. Heartz represents the Shawinigan company membership in ASTM. A member of many technical and professional groups he was recently elevated to the grade of honorary membership in the ASME.

R. W. Henke, Chief Mechanical Engineer, Research & Development Div., Badger Meter Mfg. Co., Milwaukee, Wis., heads the new task group T-4F-1 on Water Meter Corrosion, of Unit Committee T-4F on Materials Selection for Corrosion Mitigation in the Utility Industry, of the NACE. Mr. Henke would wish to be informed of interested personnel willing to participate in the project. Mr. Henke may be addressed at 2371 N. 30th St., Milwaukee 45, Wis.

Charles K. Hewes, for many years Chief Chemist, Richfield Oil Corp., Wilmington, Calif., retired some months ago. He was succeeded by C. T. Brown. Mr. Hewes represented his company in the Society for a long period, serving on Committee D-4 on Road and Paving Materials and certain of its subgroups since 1939.

L. C. Hewitt, formerly Vice-President and Director of Research, Laclede-Christy Co., St. Louis, Mo., is now Director of Research, The Ironton Fire Brick Co., Ironton, Ohio.

Richard D. Hoak, Senior Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa., and an active member of ASTM Committee D-19 on Industrial Water, is current chairman of the American Chemical Society's Division of Water, Sewage and Sanitation.

Walter H. Holcroft, Executive Vice-President and Technical Director, Holcroft & Co., Detroit, Mich., received the 1955 Trinks Award, the nation's top honor for achievement in the industrial heating industry. Mr. Holcroft was cited for his outstanding contributions to gas carburizing and carbo-nitriding in heat treating steel, also for contributions to short-cycle malleable annealing furnaces and improvements on standard type conveyor furnaces.

Giles E. Hopkins, for many years Technical Director, The Wool Bureau, Inc., is now with the Rayon and Acetate Fiber

Producers Group, 350 Fifth Ave., New York City, as Research Director.

Wesley W. Horner, senior member of the St. Louis consulting engineering firm of Horner & Shifrin, received the Achievement Award of the Engineers' Club of St. Louis. A pioneer in airfield engineering, expressways, and water supply problems, he is a past-president of the American Society of Civil Engineers and the American Public Works Assn.

Ernest Howard, formerly associated with The H. A. Wilson Co., Union, N. J., is now Development Engineer, Wade Electric Products Co., Sturgis, Mich.

William S. James, Vice-President in Charge of Research and Engineering, Fram Corp., Dexter, Mich., was awarded Certificate of Appreciation by the Society of Automotive Engineers, in recognition of outstanding contributions to the work of the SAE Fuels and Lubricants Technical Committee. A longtime ASTM member, Mr. James has been very active in the work of Committees D-2 on Petroleum Products and Lubricants, and D-11 on Rubber and Rubber-Like Materials. He also served several years as a member of the Detroit District Council.

C. F. Jelinek has been named Manager of Process Research and Development at the Rensselaer, N. Y., plant of General Aniline & Film Corp.

ASTM Director J. H. Jenkins, Chief, Forest Products Laboratories of Canada, Ottawa, has been elected to the Board of Directors of the Canadian Standards Assn. Col. Jenkins' nomination to this important post was sponsored by Lumber and Timber Trade Associations from coast to coast. He is the only representative of the forest-based industries elected to the directorate of the CSA. However, for several years Col. Jenkins has been Chairman of the CSA Sectional Committee on Timber which, on a national scale, is responsible for the direction and activities of some fifteen subcommittees engaged in the preparation of specifications and standards for nearly every phase of wood utilization.

Malcolm F. Judkins, Chief Engineer, High Temperature Alloys Div., Firth Sterling, Inc., Pittsburgh, Pa., was presented with a lifetime membership in Society of Carbide Engineers.

George Kalon, formerly with Turbo Products, Inc., Pacoima, Calif., is now associated with Lockheed Aircraft Corp., Materials and Process Dept., Burbank, Calif.

Charles E. Kaufman has been appointed Manager of a newly created Chemical Product Development Department for Hagan Corp. and subsidiaries. He has been Director of Research for Hall Laboratories.

Augustus B. Kinzel has been elected Vice-President—Research of Union Carbide and Carbon Corp., New York City. He has been actively engaged in research

work with Union Carbide and Carbon Corp. since 1926. Earlier this year Dr. Kinzel was given the Morehead Award of the International Acetylene Assn., being cited for his contributions to the use of acetylene. He has pioneered in the development of weldable alloy structural steels and of alloying metals. Recently the honorary degree of Doctor of Engineering was conferred on him by the New York University College of Engineering.

Kenneth R. Knapp recently retired from the American Gas Assn. Laboratories, Cleveland, Ohio, after 44 years of outstanding service to the gas industry. He has been active through the years in ASTM technical work, serving on Technical Committee H on Light Hydrocarbons of Committee D-2 on Petroleum Products and Lubricants, also on Committees D-3 on Gaseous Fuels, and D-22 on Methods of Atmospheric Sampling and Analysis. He has just completed a term as Councilor of the ASTM Cleveland District.

Ernest C. Kron, Steel Metallurgist for Doehler-Jarvis Division, National Lead Co., Toledo, Ohio, was promoted to Division Metallurgist.

R. H. Lace, formerly with the Lincoln Paper Co., Chicago, Ill. (recently dissolved), is now Technical Director, Riverside Paper Corp., Appleton, Wis.

Clarence Lamoreaux, formerly Chief Chemist, The Federal Portland Cement Co., Inc., Buffalo, N. Y., is now Chief Chemist, The Buffalo Slag Co., Inc. Mr. Lamoreaux currently is serving as Secretary of the ASTM Western New York—Ontario District Council.

Joseph W. Lang has been named Manager of Manufacturing for the Dye and Chemical Division of General Aniline & Film Corp. He was formerly Director of Research.

Fritz V. Lenel, Professor of Metallurgy at Rensselaer Polytechnic Institute, has been authorized by Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, to continue through 1955 his program of aluminum powder metallurgy research for the center. Dr. Lenel's investigation has been in process since 1952. Dr. Lenel has been very active in ASTM Committee B-9 on Metal Powders and Metal Powder Products, serving terms as Chairman and Secretary and is the current Gillett Lecturer.

Frank M. Levy, Director of Research, Mueller Brass Co., Port Huron, Mich., has been elected Vice-President in Charge of Research.

Jules W. Lindau, III, of Southern Plastics Co., and of the University of South Carolina, Columbia, has been named Secretary of the Society of Plastics Engineers.

Francis J. Lowey, formerly with Metallic Friction Material Co., Cleveland, Ohio, is now Vice-President, Operations and

Engineering, American Brake Shoe Co., Sintermet Div., in the same city.

Myron E. Lunchick is now Supervisor, Structural Evaluation Section, David Taylor Model Basin, Washington, D. C. He was previously associated with the Republic Aviation Corp., Farmingdale, L. I., N. Y., as Structures Engineer.

H. W. Maack recently retired as Chief Chemist and Metallurgist, Crane Co., Chicago, Ill. A member of the Society for over twenty years, he had been very active in several of the ferrous committees, also in Committee B-5 on Copper and Copper Alloys.

Edward Mackasek has retired as Managing Director of the Porcelain Enamel Institute after completing eleven years of service as head of the staff operations. John C. Oliver will succeed him.

W. E. Mahin, formerly Technical Director, Vanadium Corp. of America, Cambridge, Ohio, is now Vice-President and Director of Research, Hunter Engineering Co., Riverside, Calif.

As part of the birthday celebration on May 14 for **Herman F. Mark**, just turned 60, the Institute of Polymer Research at Polytechnic Institute of Brooklyn presented a symposium on polymers in his honor. Professor Mark, who is an internationally known and respected scientist and teacher in X-rays, structure of matter and macromolecules, is head of Brooklyn Polytechnic Polymer Research Institute. He has been associated with ASTM Committees C-19 on Structural Sandwich Construction and D-23 on Cellulose. He is chairman of the Subcommittee on Molecular Chain Length of Committee D-23.

Robert W. Martin, until recently with Standard Electronic Manufacturing Co., Culver City, Calif., is now Research Engineer, Summers Gyroscope Co., Santa Monica, Calif.

ASTM Past-President **Harold L. Maxwell**, Special Assistant to Management, Engineering Dept., E. I. du Pont de Nemours and Co., Inc., Wilmington, Del., received an honorary Doctor of Science degree at the recent commencement exercises of Cornell College, Mount Vernon, Iowa. A 1916 Cornell graduate, Dr. Maxwell holds a Ph.D. in chemistry and engineering from Iowa State College, Ames.

Ray McBrien, Engineer of Standards and Research, Burnham Shops, Denver & Rio Grande Western Railroad, Denver, Colo., has been elected Junior Vice-President of the American Railway Engineering Assn.

Louis C. McCabe, until recently Chief, Fuels and Explosives Division, U. S. Bureau of Mines, Department of the Interior, has been appointed Scientist Director, Division of Sanitary Engineering Services, Public Health Service, U. S. Department of Health, Education and

(Continued on page 92)

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(Continued from page 89)

Welfare, Washington, D. C. Dr. McCabe, as Chairman of ASTM Committee D-22 on Methods of Atmospheric Sampling and Analysis, is a firm advocate of standard methods for identification and evaluation of atmospheric pollutants, dissemination of knowledge about them, and development of control processes and equipment.

J. L. McCloud, Staff Consultant, Manufacturing Engineering Office, Ford Motor Co., Dearborn, Mich., was awarded Certificate of Appreciation by the Society of Automotive Engineers, in recognition of outstanding contributions to the work of the SAE Fuels and Lubricants Technical Committee. Mr. McCloud has been active in ASTM technical work for many years, serving on Committee A-5 on Corrosion of Iron and Steel, and on Technical Committee I on Tractor Fuels of Committee D-2 on Petroleum Products and Lubricants. He also is a Past Officer and Honorary Member of the ASTM Detroit District Council.

M. H. McGrath, Chief Engineer, General Cable Corp., Perth Amboy, N. J., has been elected a Vice-President of the company.

Louis A. Melsheimer has been appointed Director of Technical Service for

the Pigments Division, American Cyanamid Co., Bound Brook, N. J.

Edward A. Miller, Manager of the Building Panel Division, Detroit Steel Products Co., Detroit, Mich., has been reelected Secretary-Treasurer of the Metal Roof Deck Technical Institute. He has held the office since 1945.

William M. Mobley, formerly Chief Chemist and Research Director, Alabama By-Products Corp., Birmingham, recently was appointed Technical Director, heading the company's new Technical Control and Research Department.

George R. Newby is now President, G. R. Newby Co., Ltd., Montreal, Canada. He was previously Welding Specialist, C. D. Howe Co., Ltd., in the same city.

N. B. Noble has retired as Administrative Manager of Standard Telecommunication Laboratories, Ltd., London, England. He is succeeded by A. Ramsey.

Irving A. Oehler was made Manager of Manufacturing, American Welding & Mfg. Co., Warren, Ohio. With the company since 1942, he was made Administrative Assistant to the President last January.

Tinius Olsen II was elected President, Tinius Olsen Testing Machine Co., Wil-

low Grove, Pa., to succeed his father, Thorsten Y. Olsen, now Board Chairman.

Frederick R. Owens, President, Cyrus William Rice and Co., Inc., Pittsburgh, Pa., has been elected to the Board of Direction of the Engineers' Society for Western Pennsylvania. Dr. Owens has been very active in ASTM Committee D-19 on Industrial Water and many of its subgroups. He is currently a Vice-Chairman of the main group.

Douglas E. Parsons, Chief, Building Technology Div., National Bureau of Standards, Washington, D. C., was awarded the Gold Medal for Exceptional Service by the U. S. Department of Commerce. The award was a tribute to Mr. Parsons' scientific achievements in the field of building research, resulting in greatly increased knowledge and far-reaching practical benefits to the building industry and the public. He has been a member of the Bureau's staff for over thirty years. A member of ASTM also for more than thirty years, Mr. Parsons was recipient of an ASTM Award of Merit (1952) in recognition of outstanding service, especially in the technical groups concerned with mortars for unit masonry and manufactured masonry units, and in administrative work. He is currently serving on the Board of Directors of the

(Continued on page 94)

Measuring Viscosity of Thermosetting Resins by Parallel Plate Plastometry

In a recent article (ASTM Bulletin February 1955) D. I. Marshall of Bakelite Company sets forth this conclusion:

CONCLUSION

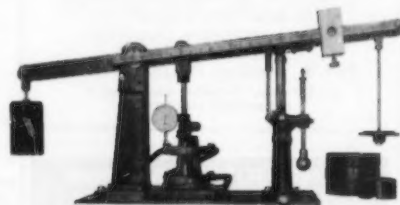
The parallel plate plastometer was found useful for measuring viscosity at various temperatures and viscosity changes during thermal hardening on various types of thermosetting resins. Rapid temperature equilibrium, fast viscosity reading, and lack of a cleaning problem make it particularly suitable for thermosetting type substances.

Viscosity data and parameters obtained from viscosity-time curves are useful as indications of rheological changes caused by polymerization and cross-linking during fabrication with thermosetting resins in molding material and bonding applications.

Scott Testers has for a number of years made available a commercial unit for this test

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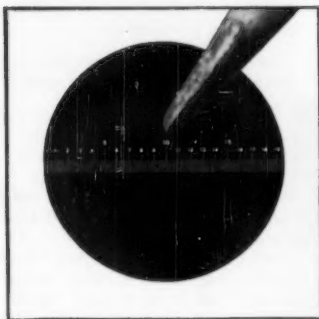
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Note we say "more than" 1,000 lines per millimeter. We have never been able to devise a situation that drives the resolving power of these plates to its inherent limit. It's too difficult to form and lay down an optical image that fine. The widths of lines or spaces in such a pattern would equal the wavelength of blue light itself!

We crow so because we have just set up new and costlier manufacturing and inspection facilities for *Kodak High Resolution Plates* in order to keep them freer of scratches and specks than was possible when they were known as "Type 548-GH" and were worked in with the production of experimental plates. The special facilities should result in higher yields of high-quality reticles, but they must be kept busy or it's no go. Therefore, we crow to attract more users so that we shall continue to have something to crow about. (Business, too, has its sub-

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Kodagraph Micro-File Film—Higher resolving power, more contrast, and higher maximum density (all valuable attributes for document copying), at the expense of beauty in tone rendition.

Kodak Linagraph Shellburst Film—Special characteristics for photographing objects against a bright sky.

Kodak Photofluor Film—For photography from fluorescent screens, as in mass chest x-ray surveys. Available in blue-sensitive and green-sensitive types.

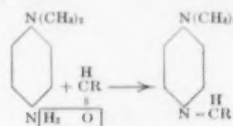
On 70mm color film, we can't be quite so prompt, but if you'll place an order for 14 rolls of 70mm *Kodak Ektachrome Film*, we'll put it up just for you. Since with this film you make your own processing arrangements, it can be examined as full-color transparencies 65 minutes after it leaves the camera.

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For aromatic aldehydes, the resultant anils come out immediately in crystals of characteristic form, color, and melting point. For most of the aliphatic aldehydes, the anils must be extracted from solution with 30% acetic acid. So confident are the authors of the insensitivity of the reaction to ketones that they sometimes use acetone as their solvent. We can supply an abstract of their procedure without obligation.

The only reason we list our purified *N,N*-Dimethyl-*p*-phenylenediamine (Eastman P2147) as Practical Grade is that like most good free aromatic amines it slowly darkens spontaneously. Wise as we are in the ways of aromatic amines, we don't know what the brown chromophore is. If this worries you and if you are willing to complicate the procedure to avoid worry, you can buy our *N,N*-Dimethyl-*p*-nitrosoaniline (Eastman 188) and reduce this Eastman Grade material with zinc dust in the presence of ammonium chloride, as the *Helvetica* authors did.

For the analytical abstract and for our List No. 39 of some 3500 other Eastman Organic Chemicals, write Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are... serving laboratories everywhere



(Continued from page 92)

Society and as a member of the administrative Committee on Standards.

M. Rea Paul, formerly with The Eagle-Picher Co., Washington, D. C., is now associated with Solvay Process Div., Allied Chemical and Dye Corp., New York City.

Klem Petrosius, until recently with Nash Motors Div., American Motors Corp., Kenosha, Wis., is now Plating Engineer, National Plating Co., Chicago, Ill.

Ethel Phelps retired in June as Professor of Textiles and Clothing, Division of Home Economics, University of Minnesota, University Farm, St. Paul, after forty years of teaching, research, and public service. Miss Phelps was one of the first two home economists to belong to ASTM. In the School of Home Economics at the University of Minnesota she developed advanced courses and graduate and research programs in her field and was responsible for the development of outstandingly well equipped research laboratories for textile work at the University. Her most important contributions to research have been the effects of laundering on fabrics, the wearing qualities of wool and cotton fabrics, as well as those made of chemically manufactured fibers, and the characteristics of yarn and

fabrics made of flax fiber from Minnesota seed flax straw. She has cooperated with home economics workers in the U. S. Department of Agriculture on nationwide studies and has had assignments as chairman of special committees for the home economics section of the Association of Land-Grant Colleges and Universities. Joining ASTM in 1924 she immediately became affiliated with Committee D-13 on Textile Materials, rendering valued service through the years on many of the subgroups and sections.

Malcolm L. Playfair, formerly with Associated Laboratories, Portland, Ore., is now Chief Chemist, Pittsburgh Testing Laboratory, in the same city.

R. A. Pomfret has been promoted to Chief, Development and Research, Central Technical Dept., Shipbuilding Division of Bethlehem Steel Co., Quincy, Mass. He succeeds **Paul Ffield** who was recently transferred to Bethlehem, Pa., as Technical Adviser on the staff of the operating Vice-President. Mr. Pomfret joined the Bethlehem organization in 1935 as Assistant Materials Engineer, and later became Materials Engineer, which position he held prior to taking over his new duties.

Howard K. Preston, Professor and Head of the University of Delaware's Department of Theoretical and Applied Mechanics, Newark, Del., retired early

this year. He had been on the faculty for over thirty years. **Paul J. Brennan**, Chairman, Civil Engineering, now represents the University's membership in ASTM.

Ray Quadt, Director of Research and Development, Hunter Douglas Corp., Riverside, Calif., has been promoted to Assistant Vice-President. Mr. Quadt also will continue his duties as Director of Research and Development.

Maurice Rand is now associated with Thomasset Colors, Inc., Newark, N. J.

John Edward Rehder, Director, Technology and Research, Canada Iron Foundries, Montreal, received the 1955 Peter L. Simpson Gold Medal of the American Foundrymen's Society "for outstanding contributions to the Society and to foundry knowledge of cast metals." He is the third Canadian so honored by AFS. A tireless worker in castings research, Mr. Rehder has been equally tireless in his willingness to impart something of his extensive metallurgical knowledge to others.

P. James Rich, formerly Technical Director, Kwikset Locks, Inc., Anaheim, Calif., is now Technical Director, Harvey Machine Co., Torrance, Calif. Dr. Rich has been active in Committees B-6 on Die-Cast Metals and Alloys, and B-8 on Electrodeposited Metallic Coatings; and is currently a member of the Southern California District Council. He is Chair-

(Continued on page 96)

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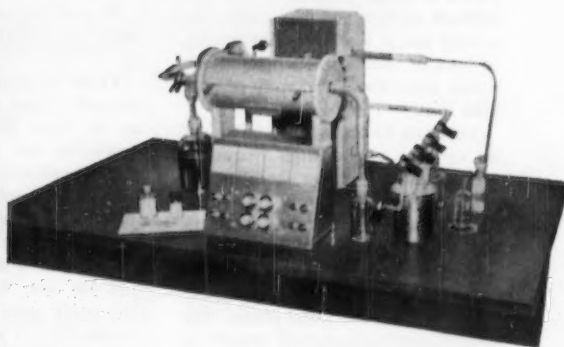
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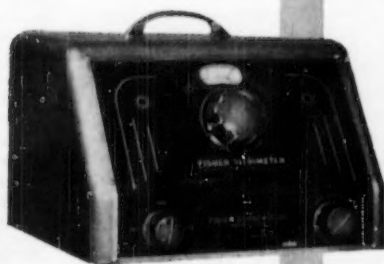
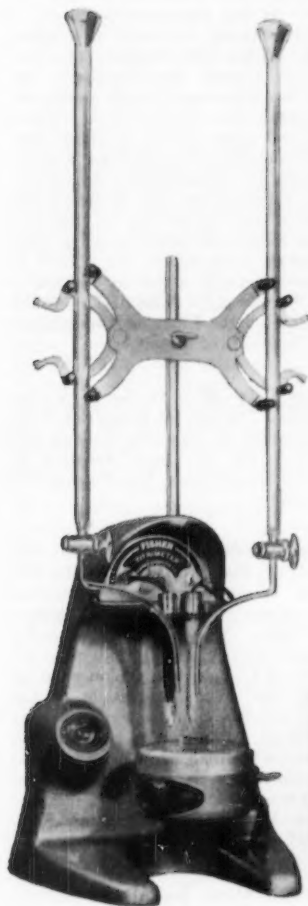
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(Continued from page 94)

man of the Technical Program Committee for the Second ASTM Pacific Area National Meeting, to be held in Los Angeles in September, 1956.

Ernest L. Robinson recently retired from active service with the General Electric Co., Schenectady, N. Y. Mr. Robinson has made valued contributions to the work of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, serving on the main group and numerous of the Panels for the past 21 years. He was chairman of the Joint Committee for a number of years. Mr. Robinson's home address is 1757 Wendell Ave., Schenectady 8, N. Y.

John H. Romann, formerly President, The Prescott Co., Menominee, Mich., has been made Chairman of the Board of Directors of the company. His address now is 1412 Government St., Mobile, Ala.

Carlton H. Rose recently was appointed Director of Public Relations, National Lead Co., New York City. Employed by the company in 1924 as a technical representative for the Pacific Coast Branch, Mr. Rose was transferred in 1932 to the Brooklyn Research Laboratories as a research chemist and subsequently became head of the Pigment and Paint Department of the Laboratories. In 1950 he was transferred to the Washington, D. C., office where he became manager the following year. Mr. Rose has been very active in ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products, serving as its Secretary for eight years. He is a Past Director of the Society and in 1953 was given an ASTM Award of Merit in recognition of valued contributions in both administrative and technical activities.

Joseph D. Ryan recently became Director of Research, Libbey-Owens-Ford Glass Co., Toledo, Ohio, succeeding George B. Watkins who was promoted to permanent Chairman of the Technical Policy Committee. The company has announced a realignment of its research and development departments to give greater impetus to development of new glass products and improved service to customers. Other new assignments include promotion of **Roy W. Wampler** to Associate Director of Research, and appointment of **Howard R. Swift** as Chief of the Glass Technology Section.

E. A. Ryder, Consulting Engineer, Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., is retiring from the company after nearly thirty years' service. Mr. Ryder, whose address is 6 Oak Ridge Lane, West Hartford 7, Conn., plans to engage in general consulting work. He has represented his company in the Society for many years, serving on Committee D-2 on Petroleum Products and Lubricants and on a number of the subgroups.

W. N. St. John is now Product Manager, Silicone Rubber Div., Hewitt Rubber Div., Hewitt-Robins, Inc., Buffalo, N. Y.

Mortimer F. Sayre has retired as Chairman, Department of Mechanical Engineering, Union College, Schenectady, N. Y. He plans to continue his consulting work.

Sears, Roebuck and Co., Chicago, Ill., recently held official groundbreaking ceremonies for their new central paint research laboratory which when completed will serve as the research and development center for Sears' seven paint, varnish, and wallpaper plants.

J. B. Seastone, formerly with Westinghouse Electric Corp., East Pittsburgh, Pa., is now Manager, Research and Development, Metals Division, Olin-Mathieson Chemical Corp., East Alton, Ill.

Laurence C. Shaw has retired as Chief Chemist, Avon Sole Co., Avon, Mass. He is succeeded by Pasquale A. Uva.

C. G. Siding, until recently Chief Engineer, has been made Vice-President in Charge of Manufacturing and Engineering, Acme Aluminum Foundry Co., Chicago, Ill.

Thomas P. Simpson has been elected Vice-President and Director of Manufacturing, General Petroleum Corp., Los Angeles, Calif., succeeding **Gale L. Adams**, who retired after 29 years with the company.

Harold M. Smith, Regional Director, Region IV, Bureau of Mines, Bartlesville, Okla., and Vice-Chairman of ASTM Committee D-2 on Petroleum Products and Lubricants, was presented with an illuminated scroll in recognition of his past services to the American Petroleum Institute. Before appointment as Regional Director, Mr. Smith was Director of API Research Project 48 and Chief, Chemistry and Refining Branch, at the Bureau of Mines, Bartlesville. The scroll says in part: "Under his competent direction more information about the sulfur compounds in petroleum has been accumulated (by Project 48) in the last six years than during the preceding fifty"; also, "his many contributions to knowledge in the field of petroleum composition will be of lasting value to the petroleum industry."

Robert B. Sosman, Visiting Professor, School of Ceramics, Rutgers University, New Brunswick, N. J., and Chairman, ASTM Committee C-8 on Refractories, has been elected an honorary member of the British Ceramic Society. (See page 17 for news of Dr. Sosman's receipt of a 1955 ASTM Award of Merit.)

Frank N. Speller, Metallurgical Consultant, Pittsburgh, Pa., and ASTM Honorary Member and former Director of the Society, was elected to honorary membership in the ASTM Pittsburgh District Council "in appreciation of services rendered."

J. E. Stareck has been appointed Director of Research of Metal & Thermit Corp., New York City, producers of metals, industrial chemicals, welding equipment and

supplies. In his new post he will continue also to direct the research activities of United Chromium, Inc., a subsidiary of Metal & Thermit.

Alexander Steward, Director of Research, National Lead Co., New York City, received the honorary degree of Doctor of Engineering during the recent 100th anniversary exercises of the New York University College of Engineering.

John A. Succop, Chief Metallurgical Engineer, Heppenstall Co., Pittsburgh, Pa., was 1955 recipient of the David Ford McFarland Award of the Penn State Chapter of the American Society for Metals. At the presentation dinner in April Mr. Succop delivered a technical address entitled "Development of a Die Block for Closed Die Forging." Mr. Succop has contributed much to the development of alloy steel die blocks for drop forging and press forging in closed dies, and has contributed in many ways to the production of various heavy forged machinery components. He is one of the leaders in the production of modified stainless steels and superalloys for high-temperature applications. In ASTM he has been especially active in Committee A-1 on Steel, and the Joint ASTM-ASME Committee on the Effect of Temperature on the Properties of Metals.

Robert L. Terrill, of Snyder, N. Y., has been named Manager of Industrial Products Research by Spencer Kellogg and Sons, Inc. He had been Assistant to Alexander Schwarzman, Vice-President of the company.

Moyer D. Thomas, of Stanford Research Inst., Stanford, Calif., is the first recipient of the Frank A. Chambers Award presented by the Air Pollution Control Assn. Named for the late head of the smoke inspection and abatement department of Chicago and a pioneer in air research, the award was made to Dr. Thomas principally for his development of the Thomas Autometer, a recording instrument for the analysis and measurement of sulfur dioxide in the air. In ASTM Dr. Thomas is active in the work of Committee D-22 on Methods of Atmospheric Sampling and Analysis.

Rudolph Valore, Jr., Materials Engineer, Structural Engineering Section, Building Technology Division, National Bureau of Standards, was awarded the Wason Medal of the American Concrete Inst. for the most meritorious paper published in *ACI Proceedings* during 1954. The paper, "Cellular Concretes," which won the award reviewed methods of preparation and physical properties of moist-cured and high-pressure steam-cured cellular concretes, ranging in density from 10 to 100 lb per cu ft, as they have evolved in Europe in the past 30 years. Mr. Valore is an active member of ASTM Committee C-9 on Concrete and Concrete Aggregates.

Kent R. Van Horn, Director of Research, Aluminum Company of America,

New Kensington, Pa., received an honorary degree of Doctor of Science from Case Institute of Technology. Well known throughout metallurgical and metal research circles, Dr. Van Horn is an authority on industrial X-ray. In ASTM he has been for many years an active member of Committee E-7 on Non-Destructive Testing, serving as chairman of the group which drafted E 52, Industrial Radiographic Terminology for Use in Radiographic Inspection of Castings and Weldments.

Evan W. Vaughan, formerly with Canadian Brazilian Services, Ltd., Toronto, is now Hydraulic Engineer, Parsons, Brinckerhoff, Hall & Macdonald, New York City.

T. E. Veltfort has been reelected Manager of the Copper & Brass Research Assn., New York City.

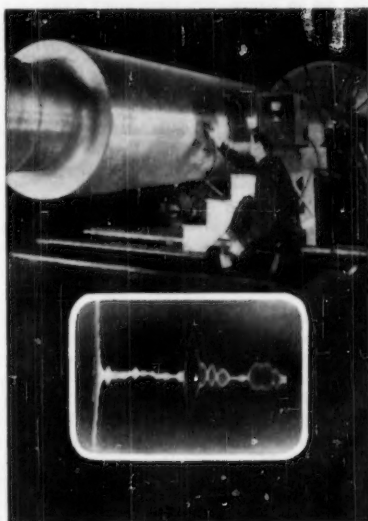
J. F. Voelker has been appointed Chemical Engineer of Penn-Dixie Cement Corp., Nazareth, Pa., succeeding William P. Gano, who retired after 51 years of service with Penn-Dixie and two of its predecessor companies.

Fred J. Walls, Manager, Detroit Office, Development and Research Division, The International Nickel Co., Detroit, Mich., was the Charles Edgar Hoyt Memorial Lecturer at the recent convention of the American Foundrymen's Society. He was selected as chief convention speaker because of his long-standing interest in improving the quality level of foundry education and his constant encouragement of young men to enter the metal castings industry. Title of the lecture was "Education and the Future Foundryman."

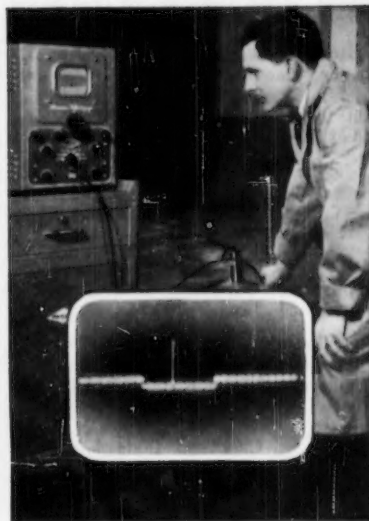
C. Earl Webb has retired as Chief Engineer, American Bridge Division, United States Steel Corp., Pittsburgh, Pa. Mr. Webb has represented his company in the Society and on Committees A-1 on Steel and D-1 on Paint, Varnish, Lacquer and Related Products for many years.

Robert W. Webb, of the U. S. Department of Agriculture, Division of Cotton Marketing, and often called the "father of cotton fiber technology in the USDA" recently received considerable publicity in the technical press, recognizing his accomplishments during 27 years of concentrated work on the development of methods of measuring and evaluating cotton fiber properties in relation to spinning quality. Dr. Webb invented a machine for separating cotton fibers according to length, and developed the first modern cotton-fiber laboratory in America. Quoting from an early 1955 issue of "The Cotton Gin and Oil Mill Press"—"In the cotton industry we probably owe Dr. Webb many times the amount we have paid him as a government worker in the past one-third of a century. His work has added millions of dollars to the income of cotton growers, ginners, and spinners." Dr. Webb is a long-time member of ASTM Committee D-13 on Textile Materials, for

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See catalogue 1h-Sp in Sweet's 1955 Plant Engineering File.

many years serving as chairman of the Cotton Subcommittee.

Walter H. Wheeler, Consulting Engineer of South Minneapolis, Minn., was named "Roster Engineer" for 1955 by the Engineers Club of Minneapolis.

Robert A. Willey, formerly Chief Metallurgist, Commercial Steel Casting Co., Marion, Ohio, has been appointed Assistant Technical and Research Director, Steel Founders' Society of America.

James Woodbury, formerly with the Great Lakes Carbon Corp., Niagara Falls, N. Y., is now Metallurgist, Griffin Wheel Co., Chicago, Ill.

W. A. E. Woods, formerly Vice-President, is now President, Texas Steel Co., Fort Worth, Tex.

William T. Wright, civil and structural engineer and member of the architectural engineering firm of Kistner, Wright, and Wright of Los Angeles, has been reappointed to the California Board of Registration for Civil and Professional Engineers by Governor Goodwin J. Knight. First appointed in 1953, Mr. Wright is now to serve a four-year term.

C. I. Young has been named Vice-President-General Manager, Laclede-

Christy Division, H. K. Porter Co., St. Louis, Mo. Until recently he was Vice-President in Charge of Operations at all Laclede-Christy plants.

Dana Young, Professor and Chairman of the Civil Engineering Department of Yale University, has been appointed Dean of the School of Engineering. Dr. Young has taught at the Universities of Connecticut, Minnesota, and Texas and has been employed also by various engineering companies including Shell Petroleum Corp. and United Engineers & Constructors.

DEATHS...

Charles R. Amberg, Director of Research, Research Laboratory, State University of New York College of Ceramics at Alfred University, Alfred, N. Y. (May 23, 1955). Member since 1944 and representative of the University College of Ceramics on Committee C-12 on Mortars for Unit Masonry and its Subcommittees II on Research; also on Committee C-15 on Manufactured Masonry Units, and Subcommittees VI on Glazed Brick and Tile, and VIII on Clay Filter Brick. A recognized authority in his field, Dr.

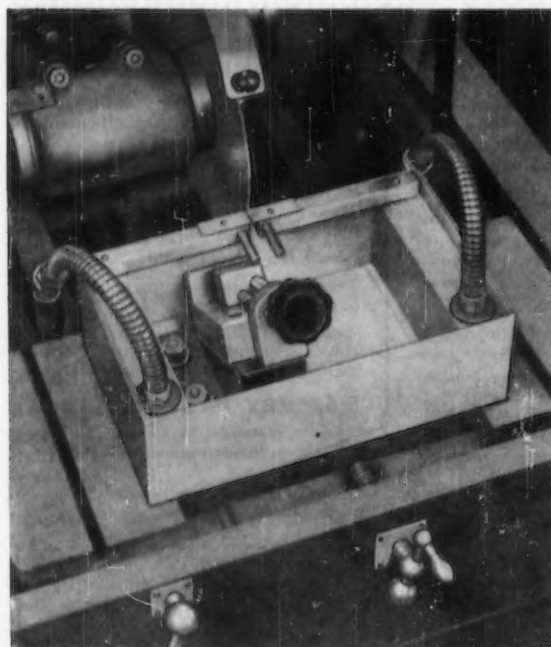
Amberg's loss will be felt by the ceramic industry as a whole, and in ASTM by those committee members with whom he had been associated.

John Henry Bateman, Professor of Civil Engineering, College of Engineering, Louisiana State University, Baton Rouge, La. Representative of the University membership for many years, and a member of the ASTM Southwest District Council since 1953.

F. L. Castleman, Jr., Dean, School of Engineering, University of Connecticut, Storrs, Conn. (December 30, 1954). Representative of the University membership for many years.

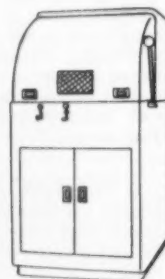
George E. Cochenour, Jr., Ordnance Inspector, U. S. Department of the Army, Pittsburgh, Pa. (May 13, 1955). Member since 1943.

Theodore L. Condron, Consulting Engineer (retired), Oak Park, Ill. (April 12, 1955). A member of ASTM since 1900, Mr. Condron had been affiliated with a number of engineering groups. He was a Past Director of the American Society of Civil Engineers, and an honorary member of the Western Society of Engineers and of the Chicago Engineers Club.



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John C. Daniels, Soils Engineer, U. S. Department of the Army, Corps of Engineers, Great Lakes Division, Chicago, Ill. (September 17, 1954). Member since 1949.

Gustav Egloff, Director of Research, Universal Oil Products Co., Des Plaines, Ill. (April 29, 1955). Member of the Society since 1926, serving for several years on Committees A-1 on Steel, and D-2 on Petroleum Products and Lubricants.

George W. Jones, Central Experiment Station, U. S. Bureau of Mines, Gas Explosions Branch, Pittsburgh, Pa. (March 4, 1955). A member of ASTM Committee D-3 on Gaseous Fuels, Mr. Jones did considerable work at various times in cooperation with the Society. During four decades he won recognition as a leading American authority on gas explosions. In 1949 he was one of the first three Bureau of Mines staff members to receive the Distinguished Service Award and Gold Metal, highest honor that the Department of the Interior can bestow.

Valentine B. Libbey, Manager, Hawaiian Bitumuls Co., Ltd., Honolulu, Hawaii (August, 1954). Member since 1937.

G. A. Lillieqvist, Research Director, American Steel Foundries, Chicago, Ill., known internationally for his contributions to the field of metallurgy, died suddenly of a heart attack on May 31, 1955. Representative of his company's membership in the Society for many years, he had made outstanding contributions to the technical activities in Committees A-1 on Steel and E-7 on Non-Destructive Testing. A member of a number of technical and professional organizations, he received the 1933 R. W. Hunt Award of the American Institute of Mining and Metallurgical Engineers and the 1952 Technical and Operating Medal of the Steel Founders' Society.

Earl W. Lyon, Consulting Engineer, Valencia, Pa. (February 11, 1955). Member since 1951.

C. H. Masland, II, Vice-President, C. H. Masland & Sons, Carlisle, Pa. (April 9, 1955). Member since 1934, and active on Committee D-13 on Textile Materials and its Subcommittee A-11 on Pile Fabrics.

A. Roy Pafenbach, Supervisor, Quality Surveys, United States Steel Corp., Pittsburgh, Pa. (July 1, 1954). Member since 1946.

Henry T. Shelley, Consulting Engineer, and Vice-Chairman of the Delaware

River Joint Toll Bridge Commission, died at his home in Milford, N. J., on April 2, 1955, at the age of 87. An ASTM member since 1913, Mr. Shelley had been active in his earlier years on a number of the technical committees, also served as a Director of the Society (1926-1928). Mr. Shelley was a former City Engineer in Philadelphia, also served four terms as mayor of Milford, N. J. He was a Past-President of the Eastern Clay Products Assn. of Philadelphia, and Secretary of the Engineering Club of Philadelphia.

Frank C. Smith, Chief Metallurgical Engineer, Bethlehem Pacific Coast Steel Corp., San Francisco, Calif. (May 6, 1955). Representative of company membership since 1948 and more recently a personal member of the Society, Mr. Smith had been a member of Committee A-1 on Steel and its Subcommittee V on Steel Reinforcement Bars since 1952; also was an active member of the Northern California District Council, serving for some years on its local Membership Committee.

W. E. Steiner, Chief Chemist, Johnstown Plant, Bethlehem Steel Co., Inc., Johnstown, Pa. (January 21, 1955). Member since 1935, and active through the years on Committees D-19 on Indus-

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trial Water, and E-3 on Chemical Analysis of Metals, and a number of the respective subgroups.

Stephen M. Swain, Director of Research North American Refractories Co., Cleveland, Ohio (May 22, 1955). Member since 1940, serving on Committee C-8 on Refractories during the entire period and heading the activities of a number of the subgroups and sections. At the time of his death he was Chairman of Subcommittee II on Research and of Section

G on Porosity and Permanent Volume Change of Subcommittee III on Tests.

L. C. Walsh, Chief Chemist, Walker Bros., Conshohocken, Pa. (May, 1955). Member since 1944.

Clarence J. Witsberger, Electrical Engineer, Pennsylvania Transformer Co., Canonsburg, Pa. (May 19, 1955). Member since 1948 serving on Committee A-6 on Magnetic Properties and its Subcommittee II on Methods of Sampling and Test.

NEW MEMBERS

The following 195 members were elected from May 30 to June 30, 1955, making the total membership 8000.....Welcome to ASTM

Note—Names are arranged alphabetically—company members first, then individuals. Your ASTM Yearbook shows the areas covered by the respective Districts.

CHICAGO DISTRICT

Freeman Chemical Corp., Stephen E. Freeman, President, Saukville, Wis.
Barrett, Fred S., Architectural Draftsman, Engineering Dept., Kraft Foods Co., 500 Peshtigo Court, Chicago 90, Ill.
Boatman, Harold R., Quality Control Dept., Inland Steel Co., 38 S. Dearborn St., Chicago 3, Ill.
Borgelt, Marvin F., Treasurer, Bituminous Surface Treating Co., Minneapolis, Minn. For mail: 1629 E. River Terrace, Minneapolis 14, Minn.
Broughton, Dean C., Research Supervisor, A. O. Smith Corp., 3533 N. 27th, Milwaukee, Wis. For mail: 2828 N. 92nd St., Milwaukee 10, Wis.
Clark, Robert E., Quality Control Supervisor, Johnson & Johnson, 4949 W. 65th St., Chicago 38, Ill.
Coombs, A. J., Chief Chemist, Marquette Cement Manufacturing Co., 52nd and Park, Des Moines, Iowa.
Cox, Daniel J., Ordnance Engineer, Ordnance Ammunition Command, U. S. Department of the Army, Joliet, Ill. For mail: 804 Greenwood Ave., Joliet, Ill.
Cundy, Paul E., Supervisor, Technical Service Lab., Process Engineering Dept., Marathon Corp., Menasha, Wis.
Feldman, William J., Secretary, Lake-River Terminals, Inc., Box A, Argo, Ill.
Forrest, Kenneth, Chief Engineer, Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill. For mail: 1754 N. Luna Ave., Chicago 39, Ill.
Goetz, William H., Research Engineer and Associate Professor, Purdue University, Civil Engineering Bldg., Lafayette, Ind.
Goldsmith, Marc S., President and General Manager, Goldsmith Brothers, Smelting and Refining Co., 111 N. Wabash Ave., Chicago 2, Ill.
Gotha, Russell F., Metallurgist, Stewart Die Casting, Division of Stewart Warner Corp., 4535 Fullerton Ave., Chicago, Ill.
Gullings, LeRoy V., Technical Service Director, American Rock Wool Corp., Wabash, Ind. For mail: 126 Parkway Dr., Wabash, Ind.
Hussey, James H., Chief Chemist, U. S. Reduction Co., 4610 Melville Ave., East Chicago, Ind.
Juster, Nathan B., Supervisor, Quality Control, The Inland Steel Co., 38 S. Dearborn, Chicago 3, Ill.
Morrison, R. L., Chief Engineer, Engineering Dept., United Electric Coal Cos., 64 S. First Ave., Canton, Ill.
Pruess, Everett A., Assistant Chief Engineer, Allis-Chalmers Manufacturing Co., Cedar Rapids, Iowa.

Reese, Charles E., Soils Engineer, William H. McFarland, 333 Front St., Binghamton, N. Y. For mail: Box 211, Angola, Ind.
Winters, Walter F., General Manager, Rubarite Corp., 141 W. Jackson Blvd., Chicago 4, Ill.
Young, H. A., Chief Chemist and Metallurgist, Crane Co., 4100 S. Kedzie Ave., Chicago 5, Ill.

CLEVELAND DISTRICT

Carroll, Walter, Metallurgical Engineer, Republic Steel Corp., Box 6778, Cleveland 15, Ohio. For mail: Box 211, Angola, Ind.
Hughes, Myron A., Chief Metallurgist, United States Steel Corp., 912 Salt Spring Rd., Youngstown 9, Ohio.
Jatczak, Edmund J., Test Engineer, Tectum Division, Alliance Manufacturing Co., 105 S. Sixth St., Newark, Ohio. For mail: 480 N. Cedar St., Newark, Ohio.
Kirk, Walter B., Chief Research Engineer, American Gas Assn., Inc., Laboratories, 1032 E. 62nd St., Cleveland 3, Ohio.
Latiano, W. D., President, Ohio Metallurgical Service, Inc., S. Abbe Rd., Elyria, Ohio. For mail: 235 Eastern Heights Blvd., Elyria, Ohio.
Mentzer, Donald E., Chemist, National Carbon Research Laboratories, Box 6087, Cleveland 1, Ohio.
Schoenberg, William, Technical Sales, Lord & Schoenberg, 1878 E. Eighteenth St., Cleveland 14, Ohio.
Wright, Richard C., Manager, Research and Development, Iron Fireman Manufacturing Co., 3170 W. 106th, Cleveland 11, Ohio.

DETROIT DISTRICT

Corsi, George L., Chief Applications Engineer, National Motor Bearing Co., Inc., Redwood City, Calif. For mail: 726 Lothrop, Detroit 2, Mich.
Eldred, Norman O., Consulting Chemical Engineer, 508 Draper St., Vicksburg, Mich.
Fowler, William, Plant Metallurgist, Plant #2, Doehler-Jarvis Division, National Lead Co., Smead and Prospect, Toledo 1, Ohio.
Hewlett, Thomas H., Principal, O'Dell, Hewlett & Luckenbach, 950 N. Hunter Blvd., Birmingham, Mich.
Kron, Ernest C., Division Metallurgist, Doehler-Jarvis Division, National Lead Co., Toledo 1, Ohio.
LaCroix, Edward J., Research Engineer, Michigan Wisconsin Pipe Line Co., 500 Griswold St., Detroit, 26, Mich.

Sniderman, Albert, Owner, Mobile Testing Laboratory, 21464 Margareta, Detroit 19, Mich.

Tadsen, Virgil S., Chief Chemist, The Gibsonburg Lime Products Co., Gibsonburg, Ohio.

NEW ENGLAND DISTRICT

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Plastic Coating Corp., The, J. J. Uber, Director of Research, Box 391, Holyoke, Mass.
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Akam, Walter, Supervisor of Testing and Research, Marriner Combing Co., Lawrence, Mass.
Anderson, Albert E., Chemical Director, Plastic Film Corp. Plainfield, Conn.
Dudzik, Chester J., Development Engineer, Universal Winding Co., Box 1605, Providence 1, R. I.
Gregory, Douglas W., Development Engineer, Polymers, Inc., Middlebury, Vt.
Sheehan, Robert P., Group Leader, R. & E. Sprague Electric Co., North Adams, Mass.
Sherburne, Carleton D., Research Chemist, Stanley Home Products, Inc., Easthampton, Mass. For mail: Loudville Rd., Easthampton, Mass.
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General Laboratory Supply Co., I. T. Klein, President, Box 2607, Paterson, N. J.
Gulick-Henderson Laboratories, Inc., The, Ellis S. Vieser Vice-President, 13-19 Hollywood Plaza, East Orange, N. J.
Structural Clay Products Inst., Region 2, Earl V. Franklin, Director, Kingston Lab., 1949 Grand Central Terminal, New York 17, N. Y.
Shore Instrument and Manufacturing Co., Inc., The, W. F. Shore, Jr., Secretary, 90-35 Van Wyck Expressway, Jamaica 35, N. Y.
Abrams, Arthur J., Engineer, Secon Metals Corp., 7 Intervale St., White Plains, N. Y.
Albers, Francis C., Chief Metallurgist, Chicago Pneumatic Tool Co., 2200 Bleecker St., Utica 3, N. Y.
Brister, Paul M., Co-ordinator, Engineering Dept., Babcock & Wilcox Co., 161 E. 42nd St., New York, N. Y.
Cramer, Robert F., Manufacturing and Materials Consultant, General Electric Co., I.G.E., 1 River Rd., Schenectady 5, N. Y.
Davey, John S., Vice-President, Russell, Burdall & Ward Bolt and Nut Co., Port Chester, N. Y.
Devine, John H., Jr., Electrical Engineer, Material Laboratory, New York Naval Shipyard, Brooklyn 1, N. Y. For mail: 120-07 224th St., Cambria Heights, 11, N. Y. [J]**
DiMeo, Armand, Chief Chemist and Colorist, Lee Dyeing Company of Johnstown, Inc., 328 N. Perry St., Johnstown, N. Y. For mail: 124 Kingsboro Ave., Gloversville, N. Y.
Dyrkacz, W. W., Associate Director of Research, Allegheny Ludlum Steel Corp., Watervliet, N. Y.
Edwards, Gordon W., Vice-President in Charge of Sales, Kensico Tube Co., Inc., Mount Kisco, N. Y.
Gillman, Harmon H., Technical Superintendent, Bishop Manufacturing Corp., Cedar Grove, N. J.
Giraudi, Germinal, Consulting Textile Engineer, Cosa Export, 161 E. 42nd St., New

* [S] denotes Sustaining members.

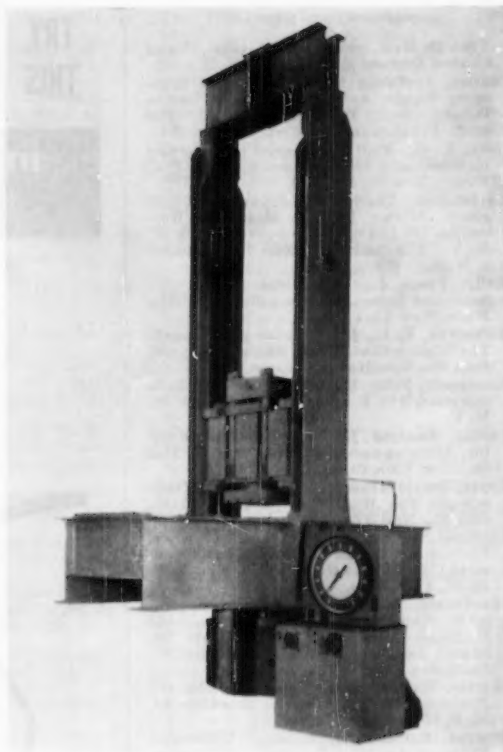
** [J] denotes Junior members.

(Continued on page 102)

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- Glazier, Frederick P.**, Chief Project Engineer, Wright Aeronautical Div., Curtiss-Wright Corp., Wood-Ridge, N. J. For mail: 593 Baylor Ave., River Vale, N. J.
- Gray, T. G.**, Staff Engineer, Cities Service Research and Development Co., 60 Wall Tower, New York 5, N. Y.
- Heidengren, Charles R.**, Junior Civil Engineer, Moran, Proctor, Mueser, & Rutledge, 420 Lexington Ave., New York 17, N. Y. For mail: 371 Etna St., Brooklyn 8, N. Y. [J]
- Kelly, Frank L.**, Vice-President, Colonial Sand and Stone Co., Inc., 30 Rockefeller Plaza, New York, N. Y.
- Kilbourne, F. L., Jr.**, Director of Research, The Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.
- Konstandt, Felix**, Director, Konstandt Laboratories, 118 E. 28th St., New York 16, N. Y.
- LaBrie, Laurent J.**, Technical Co-ordinator, Morningstar-Nicol, Inc., 630 W. 51st St., New York 19, N. Y.
- Laxer, Gerald**, Director of Science and Technology, The Wool Bureau, Inc., 16 W. 46th St., New York 36, N. Y.
- Lindgren, Vincent V.**, Technical Director, Plastics and Resins Div., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.
- Macdonald, A. R.**, Sales Manager, Instrument Development Laboratories, 163 Highland Ave., Needham Heights 94, Mass. For mail: 151 Academy Place, W. Hempstead, N. Y.
- Marvin, Walter, Jr.**, Engineer, Templar Oil Products Co., 125 51st St., Brooklyn 32, N. Y. [J]
- Murray, Raiborn H.**, Assistant Utilization Engineer, American Gas Assn., 420 Lexington Ave., New York 17, N. Y.
- Page, Edgar J.**, Chief Chemist, Belding Hemingway Corticelli, Putnam, Conn.
- Palmer, Dewey H.**, Director of Product Development, Clay-Adams, Inc., 141 E. 25th St., New York 10, N. Y.
- Peloubet, Elmore M.**, Chief Metallurgist, Arthur Tickle Engineering Works, Inc., 21 Delevan St., Brooklyn 31, N. Y.
- Reynolds, Stanley I.**, Research Associate, Physical Chemistry Section, General Electric Co., Research Laboratory, Box 1088, Schenectady, N. Y.
- Rome, City of, S. H. Zingerline**, City Engineer, City Hall, Rome, N. Y.
- Sacher, Alex**, Technical Director, Standard Insulation Co., 74 Paterson Ave., East Rutherford, N. J.
- St. Peter, Robert J.**, Manager, Mica Dept., Leonard J. Buck, Inc., 1 Newark Ave., Jersey City 2, N. J.
- Sen, Digindra Mohan**, Engineer, Picatinny Arsenal, Dover, N. J. For mail: 60 Berry St., Dover, N. J. [J]
- Smith, Russell B.**, Consulting Engineer, 347 Madison Ave., New York 17, N. Y.
- Smolin, Michael**, Technical, Mearl Manufacturing Corp., 220 Westfield Ave., W. Roselle Park, N. J. [J]
- Storey, Robert L.**, Administrative Officer, Q. M. PETRI, DISTR. COMD. 7870th AU USAREUR Coms, APO 58, New York, N. Y.
- Treleven, Lloyd D.**, Technical Representative, Binney & Smith, Inc., 380 Madison Ave., New York 17, N. Y.

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Stith, Raymond J., Instructor in Civil Engineering, University of Dayton, Dayton 9, Ohio. For mail: 109 Yale Ave., Dayton 6, Ohio. [J]

Sproull, Theodore W., Metallurgist, General Electric Co., Cincinnati 15, Ohio. For mail: 6842 Montgomery Rd., Apt. 3, Cincinnati 36, Ohio.

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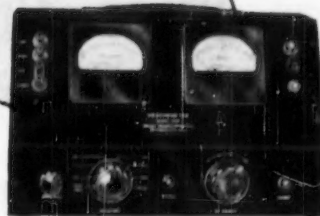
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(Continued on page 106)



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(Continued from page 104)

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Alvarez, Alejandro, Superintendent, Conductores Electricos, S. A., Poniente 140 y Norte 59, Ind. Vallejo Mexico D. F. 16, Mexico.
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Sarria-Herrera, Leopoldo, Civil Engineer, Apartada #91, Caracas Venezuela.
School of Mines, Kalgoorlie, Western Australia, R. A. Hobson, Director, Kalgoorlie, Western Australia.
Thiesse, X., Director, Pechiney-centre de Recherches, 12-18 rue des Gardinoux, Aubervilliers, Seine, France.
University Forest Administration, A. Economopoulos, Chairman of the Board, University of Thessalonica, Thessalonica, Greece.
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Wodak, Ernest F., Director, Adereth Co., Ltd., Box 2372, Tel Aviv, Israel.

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses

CATALOGS AND LITERATURE

Refrigeration Valves—New 20-page *Refrigeration Valve Catalog* illustrates and describes new products along with standard valves, filters, and driers.

A-P Controls Corp., 2450 N. 32nd St., Milwaukee, Wis.

Solenoid Valves—New 6-page 2-color bulletin covering the entire range of A-P solenoid valves.

A-P Controls Corp., 2450 N. 32nd St., Milwaukee, Wis.

Hydraulic and Pneumatic Components—This 34-page 2-color *Bulletin 155* describes and illustrates line of selector valves, restrictor valves, sequence valves, check valves, and shut-off valves.

Aircraft Products Co., 300 Church Rd., Bridgeport, Pa.

Pipe Line Filters—Line of Type "PL" Pipe Line Filters, designed for removal of water, oil, dirt, and pipe scale from compressed air or gas lines, is detailed in a new brochure.

Air-Maze Corp., 25000 Miles Rd., Cleveland 28, Ohio.

Polyvinyl Chloride—Forty-eight page general catalog, illustrating and describing complete line of polyethylene and polyvinyl chloride fabricated products.

American Agile Corp., P. O. Box 168, Bedford, Ohio.

Air Permeability—The air permeability of elastomers and similar materials may now be determined by means of the Aminco-Goodrich Air Permeability Apparatus described in *Bulletin 2262*.

American Instrument Co., Inc., Silver Spring, Md.

Powder Metallurgy—This 52-page engineering manual on *Powder Metallurgy* includes sections on bearings, component parts, and filters.

Amplex Oilite Products, P. O. Box 2718, Detroit 31, Mich.

Atcotrol—Automatic reset timer with dial setting incorporates high accuracy, compactness, extreme flexibility, and low cost for timing and sequencing of electrical load circuits (*Bulletin N-140*).

Automatic Temperature Control Co., 5200 Pulaski Ave., Philadelphia 44, Pa.

Automatic Control Systems—*Bulletin No. 8-10* describes in detail the right application of an automatic control system.

Automatic Temperature Control Co., Inc., 5200 Pulaski Ave., Philadelphia 44, Pa.

Strain Gages—1955 price list for SR-4 strain gages, instruments, accessories, and cements with revised quantity discounts.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Portable Potentiometer—*Bulletin F 5760-1* describes the Wheelco Portable Potentiometer, a unit capable of providing extreme accuracy to be used as a means of checking installations of temperature measurement and control instruments.

Barber-Colman Co., Wheelco Instruments Div., Rockford, Ill.

Temperature Control Systems—New bulletin is now available to individuals interested in the application of automatic control to industrial process applications.

Barber-Colman Co., Wheelco Instruments Div., Rockford, Ill.

Ratio-Recording Spectrophotometer—Features an extended range of 200 mμ to

3 μ plus recording linear in transmittance, linear in absorbance or direct in energy (*Bulletin 377*).

Beckman Div., Beckman Instruments, Inc., Fullerton, Calif.

Recording Spectrophotometer—*Bulletin 405* details the requirements for a variety of quantitative and qualitative applications and recommends the particular type of instrument for each use.

Beckman Div., Beckman Instruments, Inc., Fullerton, Calif.

Assembly of Pulse Systems—A simplified approach to rapid assembly of pulse test and control systems and the equipment needed to do the job are outlined in 6-page brochure, *The Unitized Approach*.

Burroughs Corp., Electronic Instruments Div., 1209 Vine St., Philadelphia 7, Pa.

Labaratus—A 64-page catalog supplement, *Labaratus*, lists 350 of the company's manufactured and specialty instruments, including a current price list.

Central Scientific Co., 1700 Irving Park Road, Chicago, Ill.

Polyethylene—Revised polyethylene catalog, *Catalog C455*.

Chicago Apparatus Co., 1735 N. Ashland Ave., Chicago 22, Ill.

Sterilizer—*Bulletin No. 23505* features new line of hot-wall, electrically heated sterilizers for temperatures up to 500 F, suitable for industrial laboratories for sterilizing glassware, evaporation tests, sample drying, etc.

Chicago Surgical & Electrical Co., 217-221 N. Desplaines St., Chicago 6, Ill.

Oscillograph Processor—A portable darkroom for on-the-spot developing and drying of oscillograms, *Bulletin 1537C*.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Vulcanized Fibre—*Diamond Vulcanized Fibre Catalog, DVF-55*, gives technical information and various specification tables.

Continental-Diamond Fibre Co., Newark, Del.

Laminated Plastic—*Dielectro Catalog D-55* gives technical information and various specification tables helpful to designers.

Continental-Diamond Fibre Co., Newark, Del.

Apparatus Digest—*Bulletin 551* presents data on apparatus and equipment for research, testing, and laboratory control.

A. Daigger & Co., Kinzie at Wells, Chicago 10, Ill.

Viscosimeter—*Bulletin No. 355* describes new industrial model Hoeppler Viscosimeter, which is built on the same order as the precision model but includes a heater with a pneumatic stirring device.

Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N. Y.

Multi-Layer Interference Films—*Bulletin No. M1-318 R* describes FS Multi-Layer, High Efficiency Interference Films utilizing the phenomenon of optical interference at the boundaries of materials of high and low index of refraction.

Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N. Y.

The Laboratory—Volume 24, No. 4 of *The Laboratory*, features all-electronic spectrograph and the Fisher Oscillating Hotplate.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Reproduction Materials—All Kodagraph materials available from the Eastman Kodak Co. for the preparation and reproduction of drawings and documents are described in detail in *Kodagraph Reproduction Materials*.

Eastman Kodak Co., Graphic Reproduction Div., Rochester 4, N. Y.

High Speed Film—New data sheet on the Cine-Kodak and Kodak High Speed Infrared Film offers complete information on loading and unloading, exposure, filters, processing, storage, sizes available, and sensitometric data on the film, which is sensitive through the visible spectrum and into the infrared to approximately 9000 Å.

Sales Service Div., Eastman Kodak Co., Rochester 4, N. Y.

Autopositive Paper Brochure—How Kodagraph Autopositive Paper is being used for engineering drawing reproduction in business and industry is told in *Autopositive in Action*.

Eastman Kodak Co., Graphic Reproduction Sales Div., Rochester 4, N. Y.

Hollow Spindle Lab-Stir—Heavy-duty hollow-spindle Lab-Stir offers continuous duty stirring of large volumes of low viscosity solutions (*Bulletin 530*).

Eberbach Corp., Ann Arbor, Mich.

Glass Tubes—Four-page, 2-color bulletin describing glass capillary tubes.

Friedrich & Dimmock, Inc., Lincoln Ave., Millville, N. J.

Plastics—Seven new and improved transparent plastics designed for better performance in countless industrial and commercial uses are described in illustrated 6-page brochure.

Homalite Corp., 11-15 Brookside Drive, Wilmington 166, Del.

Tube Benders—*Bulletin No. 303S* describes new lever-type "Blue Dot" tube benders which have design features enabling them to bend both hard or soft tubing.

The Imperial Brass Mfg. Co., 1300 W. Harrison St., Chicago 7, Ill.

X-Ray Unit—Hilger Micro-focus X-ray Unit having wide application in both diffraction and micro-radiography techniques, and featuring low exposure time, high resolution, and provision for utilization of special crystallographic procedures is described in 12-page catalog.

Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

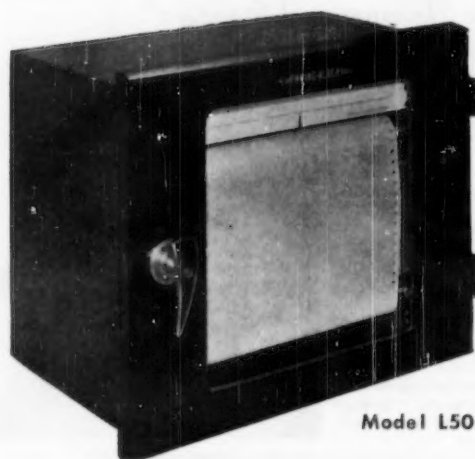
X-ray Diffractometer—*Catalog CH322/3* illustrates and describes use of instrument for qualitative and quantitative investigation of solid crystals by direct measurement of diffracted intensity using a high-speed ratio pen recorder rather than photography.

Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Metal Grating—A 16-page *Klemp Data and Specification Manual* covering all types of grating, open steel floor armor, stair treads, vessel liners, bridge decking, and drain grates.

Klemp Metal Grating Corp., 6605 South Melvina Ave., Chicago 38, Ill.

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Bulletin No. 4109 Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

High-Temperature Bath—450-F bath suitable for all types of high-temperature testing, aging, heat-treating, corrosion testing, etc.

Bulletin No. 3030 Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Roll Tester—High-temperature variable speed "Shell" Roll Tester for testing of greases at temperatures up to 750 F and variable rolling speeds of 0 to 150 rpm.

Bulletin SK-124 Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Distillator—Distillation apparatus features a quarter-turn condenser tube which permits the distillation shield to be set flush with the condenser permitting complete unobstructed observation of all receiving flasks.

Bulletin No. 4030 Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Constant-Temperature Bath—Anodized aluminum interior chamber, with thermostat control up to 160 F.

Bulletin No. 26100 Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Smoke Point—New Labline-Seta Smoke Point Apparatus for Jet Fuel Tests, ASTM

D 1322. Write for Bulletin IS 1040.

Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Vapor Pressure—Reid Vapor Pressure Tests Baths made to accommodate three or five Reid Bombs, supplied in furniture type cabinet.

Bulletin No. 4013. Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Steel Clamp—New all stainless steel clamp to hold rods up to a total diameter of 1 1/2 in.

Circular No. 1038 Labline, Inc., 217-221 N. Desplaines St., Chicago 6, Ill.

Flash Evaporator—Data sheet describes batch and continuous models of laboratory Flash-Evaporator for quickly separating solvents from solutes.

Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 26, Ill.

Analyzer for Free Residual Chlorine—Residual chlorine analyzer provides an automatic check on Cl₂ content in chlorinated water.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Millivolt Indicators—Availability of portable millivolt indicators described in a new, 4-page Data Sheet E-33(1).

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Temperature Bridges—Bench-type and portable d-c temperature bridges for temperature and temperature-difference measurements of moderate accuracy by the resistance thermometer method is now avail-

able in an illustrated 2-page Data Sheet E-33(2).

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Recorder—Two-page illustrated Data Sheet E-ND40(3) describing the "Speed-omax" X₁-X₂ Recorder.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Inductors—Two-page Data Sheet EB3 (1) describes fixed and adjustable inductors.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Permanent Fluorescent Images—Details on the production of permanent fluorescent images on Metalphoto aluminum plates are contained in a new catalog sheet.

Metalphoto Corp., 2903 E. 79th St., Cleveland 4, Ohio.

Computation Facilities—A 16-page brochure on the computational facilities and code library.

Computation Center, Midwest Research Institute, 425 Volker Bldg., Kansas City, Mo.

Quad-rings—Composition, specifications, applications, and advantages are discussed in a 10-page folder which also describes factory approved methods for installing these newly-developed hydraulic seals.

Dept. KP, Minnesota Rubber and Gasket Co., 3630 Woodale Ave., Minneapolis 16, Minn.

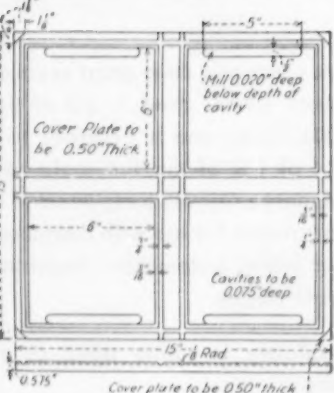
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The "International Standard" for testing the hardness of rubber and other elastomeric materials

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90-35A VAN WYCK EXPRESSWAY, JAMAICA 35, N. Y.

Industry, a 16-page, 2-color bulletin, covers the properties, grades, and uses of National vulcanized fiber and Phenolite laminated plastic.

National Vulcanized Fibre Co., 1055 Beech St., Wilmington 99, Del.

Portable X-ray Unit—A 4-page bulletin, Norelco MG 60, which gives design details and application data on a new lightweight portable X-ray unit for radiographic and fluoroscopic work in laboratories and industrial plants.

North American Philips Co., Control Instruments Div., 750 S. Fulton Ave., Mount Vernon, N. Y.

Radiochromatography—The seventh issue of the *Nucleus* describes radioactivity count rate meter and discusses in detail the principles of radiochromatography.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

Fittings for Fiber Braid Hose—Rubber-covered single fiber braid (non-metallic) hose for low-pressure service and brass reusable fittings.

Catalog Files 4480A and 4484 Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

Metal Filters—Operating engineers who deal with filtration of any liquid or gas, as well as cost and quality control executives, will be interested in catalog of sintered bronze filters, *Modern Filtration*.

Permanent Filter Corp., 1801 W. Washington Blvd., Los Angeles, Calif.

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maintenance equipment for industrial and laboratory use.

Precision Equipment Co., 3666 Milwaukee Ave., Chicago 41, Ill.

Titration Stand—Data Sheet No. 11508 on the redesigned Senior "Titra-Lite," a titration stand which provides evenly diffused "daylight" illumination for both the titration burets and flasks.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Physical Testing Machines—New 8-page bulletin describing the Richle line of physical testing machines and instruments.

Richle Testing Machines Div., American Machine and Metals, Inc., East Moline, Ill.

Controlled Volume Pumps in Water Treating—Bulletin 953 describes and illustrates how controlled volume pumps are used in typical industrial water treating systems.

Milton Roy Co., Station E, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Laboratory Equipment—Now available the 23rd edition of *What's New for the Laboratory*.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Electrical Control System—Electrical control system for predetermined repeat or nonrepeat cycle on any machine with a mechanical tripping mechanism is described in *SCI Bulletin 55-1*.

Security Controls, Inc., Dept. 7F, 225 Franklin St., Buffalo 2, N. Y.

Milohmmeters and Microhmeters—Ten highly accurate milohmmeters and microhmeters for measuring low resistances between 0.0001 ohm and 100 ohms are described in *Engineering Bulletin L-39*.

Shallcross Manufacturing Co., Collingdale, Pa.

Temperature Indicators—Brochure No. 541 contains concise directions for use; indicates the choice of temperature-indicating product for the intended application; and lists the various temperature ratings available in each of the product-types, including newly developed items in the 400- to 550-F interval.

Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

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Truesdail Laboratories, Inc., 4101-4107 N. Figueroa St., Los Angeles 85, Calif.

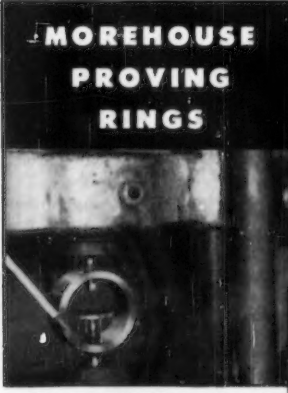
Electrode Table—Handy *Electrode Reference Table* for users of Beckman pH meters.


Will Corporation, Rochester 3, N. Y.

Temperature Controller—Application ideas and complete performance specifications for a new remote bulb, adjustable temperature controller are described in *Brochure MC-121*.

Fenwal Inc., Ashland, Mass.

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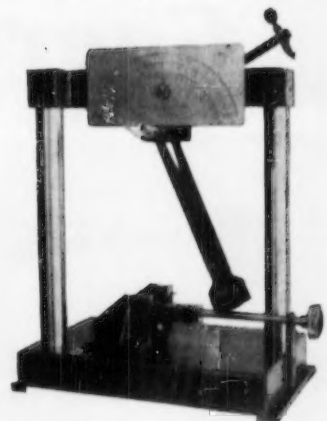
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Blue M Electric Co., 138th & Chatham St., Blue Island, Ill.

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Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Gas Chromatography—The Kromo-Tog a new unit-package instrument for gas chromatography.

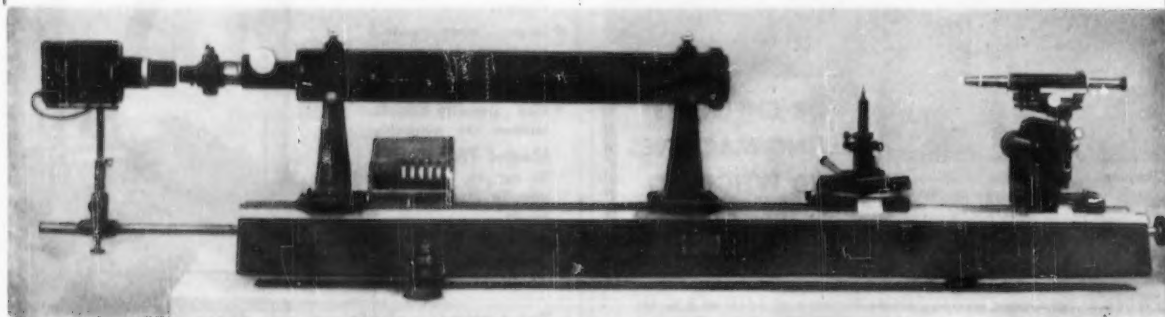
Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

(Continued on page 112)

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(Continued from page 110)

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Spring Tester—Inexpensive portable spring tester for checking loads and deflections of compression springs.

The Carlson Co., 277 Broadway, New York 7, N.Y.

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Daytronic Corp., 216 S. Main St., Dayton 2, Ohio.

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Dorber Co., 7741 W. Palatine Ave., Chicago 31, Ill.

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Dynamic Instrument Co., Inc., Cambridge, Mass.

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Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

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Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

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Freeland Gauge Co., 9940 Freeland Ave., Detroit 27, Mich.

One-Shot Viscometer—A rather unique device that is capable of measuring the viscosity of liquids in a paper cup.

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Gardner Laboratory Inc., Bethesda 14, Md.

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Gardner Laboratory, Inc., Bethesda 14, Md.

Circuit Breaker—A new two-pole common-trip circuit breaker, for use in panelboards and load centers.

General Electric, Trumbull Components Dept., Plainville, Conn.

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General Radio Co., 275 Massachusetts Ave., Cambridge, Mass.

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General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

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Gulton Mfg. Co., Metuchen, N. J.

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Fluorex—Fluorescence microscopy has extended far beyond the bounds of vital microscopy into other branches of science and technology, including chemistry, mineralogy, textiles, and paper industries.

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Industron Corp., 50 Brook Road, Needham Heights, Mass.

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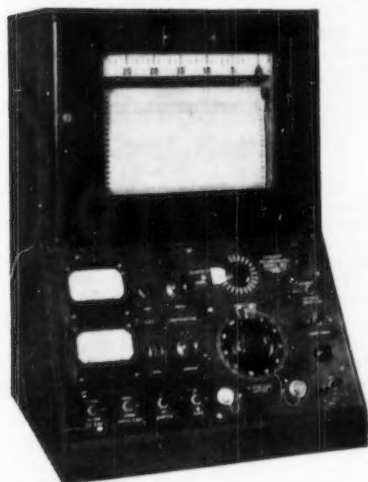
Laboratory Equipment Corp., St. Joseph, Mich.

(Continued on page 114)

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(Continued from page 112)

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Laufkin Rule Co., Saginaw, Mich.

Mercury Plunger Relay—A mercury plunger relay that will not break during shipping, installation, or use even under the most adverse conditions.

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Martin-Parry Corp., Metlwal Div., P. O. Box 964, Toledo 1, Ohio.

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Menlo Research Laboratory, Menlo Park, Calif.

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Minneapolis-Honeywell Regulator Co., Industrial Div., 4494 Wayne Ave., Philadelphia, Pa.

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Minneapolis-Honeywell Regulator Co., Doelcam Div., 1400 Soldiers Field Rd., Boston 38, Mass.

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and designed to simplify internal adjustments.

Minneapolis-Honeywell Regulator Co., Heiland Div., 132 E. 5th Ave., Denver, Colo.

High-Frequency Generators—New line of high-frequency generators for induction and dielectric heating features compact design without sacrifice of accessibility or durability.

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Neucor, Inc., 45 W. Union St., Pasadena, Calif.

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North American Philips Co., Inc., Research & Control Instruments Div., 750 S. Fulton Ave., Mount Vernon, N. Y.

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Single Crystal Camera—A new single crystal cylindrical camera, designed to take oscillation and rotation photographs of single crystal specimens on a stationary cylindrical film.

North American Philips Co., Inc., Research & Control Instruments Div., 750 S. Fulton Ave., Mount Vernon, N. Y.

Carbon-14 Compounds—Cetyl-1-C-14 alcohol and stearyl-1-C-14 alcohol in labeled form will be useful in industrial laboratories studying detergents, detergency, or liquid-liquid partition.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

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Offner Electronics, 5320 N. Kedzie Ave., Chicago, Ill.

Soil Shear Strength—Shear strength of soil can be determined quickly and easily with the K-W Unconfined Compression Testing Machine.

Tinius Olsen Testing Machine Co., 471 Easton Rd., Willow Grove, Pa.

Hardness Tester—This extremely versatile production tool employs the most accurate method of hardness testing known and is used for testing ferrous as well as non-ferrous metals of a wide range of sizes, shapes, and contours.

Tinius Olsen Testing Machine Co., 102 Easton Rd., Willow Grove, Pa.

Rubber Hardness—Rubber hardness gage has a second hand that moves with the dial hand and remains at maximum reading until turned counter-clockwise to reset. Ideal for production control and laboratory work.

W. F. Orth, 800 S. Ada St., Chicago 7, Ill.

Thermopaper—Paper thermometers for determining temperatures.

Paper Thermometer Co., 10 Stagg Dr., Natick, Mass.

Thermotube—Sealed-in-glass paper thermometers.

Paper Thermometer Co., 10 Stagg Dr., Natick, Mass.

Dynamic Balancing Machine—A ready means for accurately detecting static and dynamic unbalance in a wide range of runners, rotors, flywheels, and other rotating apparatus.

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Industrial Glove—Industrial glove of flock-lined neoprene, besides giving the wearer a maximum amount of comfort without decreasing finger dexterity, has an effective molded non-slip grip on fingers and palm.

Pioneer Rubber Co., Willard, Ohio.

Thermocon—Apparatus for analysis by low-temperature distillation, stated to be the most accurate, positive, and versatile apparatus available, of any type, for light hydrocarbon analysis.

Podbielniak, Inc., 341 E. Ohio St., Chicago 11, Ill.

Roll-About Fan—New and unique electric fan, named the Roll-About because it moves easily from one location to another on extra heavy duty rubber wheels.

Precision Equipment Co., Dept. ASTM, 3716 Milwaukee Ave., Chicago 41, Ill.

Explosion-Proof Flash Point Tester—Primarily designed to check distillate fuel shipments delivered by transport truck or tank car, the explosion-proof device is equally useful at pipeline terminals, tanker wharves, or storage tanks.

Crouse-Hinds Co., Wolf & Seventh North Sts., Syracuse, N. Y.

Reid Vapor Pressure Bombs—Redesigned Reid vapor pressure bombs used for ASTM methods D 323 and D 1267 feature easier assembly and disassembly, requiring no wrenches or other tools.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Humidity Cabinet—Used for testing the effectiveness of materials intended for the temporary protection of metals against corrosion by moisture, the cabinet produces a moisture-saturated atmosphere with continuous condensation on the test specimens.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Height Gage Scope—The Height Gage Scope is a new optical accessory for an 18-in. or 24-in. height gage.

Quality Control Co., 1566 North Western Ave., Los Angeles, Calif.

"Watchdog" Instrument—An electronic "Watchdog," which makes it possible to test and control continuously an unlimited number of industrial processes from a single vantage point.

Robertshaw-Fulton Controls Co., Fielden Instrument Div., 2920 N. 4th St., Philadelphia 33, Pa.

Thermocouple and Temperature Tester—A self-contained, combination tester for checking thermocouple output and temperature has been added to the line of instruments and controls offered by Robertshaw-Fulton Controls Co.

Robertshaw-Fulton Controls Co., Robertshaw-Thermostat Div., Youngwood, Pa.

High-Temperature Measurement—New type device of proven high accuracy for measurement of glass, surface, and gas temperatures.

Robertshaw-Fulton Controls Co., Fielden Instrument Div., 2920 N. 4th St., Philadelphia 33, Pa.

Level and Flow Control Instrument—Three variations of a standard electronic level and flow detector and controller, offering users additional sensitivity, flexibility, and economies.

Robertshaw-Fulton Controls Co., Fielden Instrument Div., 2920 N. 4th St., Philadelphia 33, Pa.

Heavy Duty Thermostat—Single, super-sensitive heavy duty wall thermostat that will control both heating and air conditioning equipment.

Robertshaw-Fulton Controls Co., Fulton Syphon Div., Box 400, Knoxville, Tenn.

Zimmerli Gage—"Wide Range" model intended for pressures up to 370 mm mercury above atmospheric and for the full barometric range of reduced pressures.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Hot-Cold Tester—Tension tester with a range of 620 F at increasingly greater extremes of high and low temperatures.

Scott Testers, Inc., 58 Weybosset St., Providence, R. I.

Electrical Control System—Versatile, simple, easily installed system for predetermined repeat or nonrepeat machine cycle provides complete control of the cycle on any machine with a mechanical

tripping mechanism by employing stored electrical energy.

Security Controls, Inc., Dept. 7F, 225 Franklin St., Buffalo 2, N. Y.

A-C Magnetic Bridge—The first magnetic bridge to be commercially available for accurately measuring permeability and core losses at inductions up to 16 kilogausses.

Shallcross Mfg. Co., Collingdale, Pa.

Rule Protractor—Measures longitudinal as well as angular dimensions, avoiding time-wasting difficulty of counting fine graduations.

George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y.

Depth Gage—A quick-acting new Maurer Vernier Depth Gage for die-makers, toolmakers, and mechanics.

George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y.

Soils—Portable unconfined compression testing machine for soils.

Soiltest, Inc., 4711 W. North Ave., Chicago, Ill.

Transistorized Clamped Flip-Flop—Plug-in transistorized clamped flip-flop with unusually low power and space requirements.

Sprague Electric Co., Marshall St., North Adams, Mass.

Rule—Steel pull-push rule permits the reading of measurements on either edge of the rule.

The Stanley Works, New Britain, Conn.

Thermostat Test Unit—Rapid testing of thermostats for quality control purposes.

Statham Development Corp., 12411 W. Olympic Blvd., Los Angeles 64, Calif.

Tester—New tester for measuring hardness and lubricity of materials, factors relating to measurement of resistance to scoring, gouging, and abrasion of materials.

Taber Instrument Corp., 111 Goundry St., North Tonawanda, N. Y.

Soil Hydrometer—Equipped with Bouyoucos grams-per-liter scale (copyrighted) to ASTM and AASHTO specifications, an improved hydrometer for determining soil particle size has been announced.

Taylor Instrument Cos., 95 Ames St., Rochester 1, N. Y.

Motor-Driven Micrometer—The Model 555 Micrometer replaces the conventional gear type movement with a synchronous motor operating in conjunction with a torque device, which assures a constant anvil pressure load at all times.

Testing Machines, Inc., 123 W. 64th St., New York 23, N. Y.

Heat Transfer Units—A heat transfer unit, designed basically to replace pipe coils.

Tranter Manufacturing, Inc., Lansing 4, Mich.

Insulator Terminals—Stand-Off and Feed-Thru insulator terminals incorporat-



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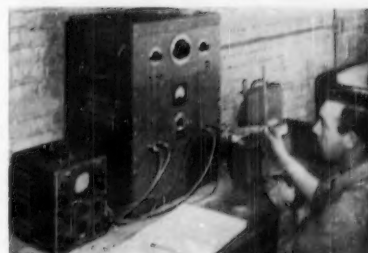
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Tri-Point Manufacturing & Developing Co., Inc., 401 Grand St., Brooklyn 11, N. Y.

Mechanical Marking Pencil—Combines the features of soft lead pencils, grease pencils, paint sticks, and crayons and will mark on any surface under any condition.

Tweeten Fibre Co., Inc., Dept. 301, 2031 Fulton St., Chicago 12, Ill.

Stiffness Tester—Universal stiffness tester, applicable to dissimilar materials and varying thicknesses, has been developed to measure stiffness and related properties of such materials as paper, coated fabrics, metal foils, and plastic sheets and films.

United States Testing Co., 1415 Park Ave., Hoboken, N. J.

Vise—New and smaller universal 3-way precision angle-set vise designed particularly for compound and simple angle grinding.

Universal Vise and Tool Co., Parma, Mich.

Electromagnet System—The V-4004 magnet with its matching power supply and optional current regulator is ideal for testing magnetic materials.

Varian Associates, Palo Alto, Calif.

Ultrasonic Energy in Liquids—Measurement of both high and low intensity ultrasonic power in various kinds of liquids may be accomplished through the use of Glennite Ultrasonic Probes.

Vibro-Ceramics Corp., Metuchen, N. J.

Temperature Measurements—A wide-range thermistor radiometer for the direct measurement of surface temperatures and environmental radiant temperatures.

Williamson Development Co., West Concord, Mass.

INSTRUMENT COMPANY NEWS

Audio & Video Products Corp., New York, N. Y.—R. E. Hadady has been elected vice president in charge of Field Engineering and James U. Lemke to vice president and chief engineer for A-V Manufacturing Corp., a division of Audio & Video.

Beckman Instruments, Fullerton, Calif.—William S. Gallaway has rejoined the Beckman Div. of Beckman Instruments, Inc., accepting the newly established post of Infrared Applications Supervisor.

H. S. Schuler has joined the Division as advertising and sales promotion manager.

A. W. Cash Co., Decatur, Ill.—John A. Wiedman has been appointed Director of Research and Development.

Compass Instrument and Optical Co., Inc., New York N. Y.—Compass Instrument and Optical Co., Inc. announce their recent move to larger quarters at 104 E. 25th St., New York 10, N. Y.

ElectroData Corp., Pasadena, Calif.—President James R. Bradburn this week announced the appointment by the ElectroData Corp. Board of Directors of

Joseph B. Rice as Vice President of Manufacturing and George B. Holmes as Assistant Treasurer.

ElectroData Corp., Pasadena, Calif.—ElectroData Corp., digital computer manufacturer of Pasadena, has named the Ottawa firm of Data Processing Associates Ltd. as its sales and service representative in Canada.

Fisher Scientific Co., Pittsburgh, Pa.—On May 17, production lines started rolling in the white-tiled air-conditioned manufacturing laboratories of Fisher Scientific's reagent-chemical plant on a nine acre site in Fair Lawn Industrial Park, a major communications point outside New York City.

G. M. Giannini & Co., Inc., Pasadena, Calif.—New division G. M. Giannini & Co., Inc. to manufacture automation equipment will be known as the Giannini Datex Div.

Hagan Corp., Pittsburgh, Pa.—A. A. Markson has been named assistant vice president in charge of engineering for Hagan Corp., Pittsburgh instrument and control firm.

Karl Heitz, Inc., New York, N. Y.—Karl Heitz, Inc., importers of the Swiss ALPA single-lens reflex camera and other precision equipment, have moved their offices and warehouse to larger quarters at 480 Lexington Ave., New York, N. Y.

High Voltage Engineering Corp., Cambridge, Mass.—Leading manufacturer of particle accelerators has announced the

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private placement of 25,000 shares of stock in the company at \$20 per share. Proceeds will be used to augment working capital and to help finance construction of a new company headquarters and production plant in Burlington, Mass., on a 45-acre site which had been previously acquired. The site is adjacent to the new circumferential highway ringing Boston, (Route 128) which is rapidly becoming a new center for electronic and scientific companies.

Labline, Inc., Chicago 6, Ill.—Labline, Inc., and its affiliate, Chicago Surgical and Electrical Co., manufacturers of laboratory apparatus and equipment, are now occupying new, modern quarters at 3070-82 W. Grand Ave., Chicago 22, Ill.

Leeds & Northrup Co., Philadelphia, Pa.—Earle D. Moiles, Jr., has been promoted from sales field engineer to district manager of the Boston office, 430 Lexington Ave., Aurburndale. He replaces Paul K. Welch, who becomes manager at New York. In becoming manager of the New York office Welch succeeds Harold L. Scutt, who recently was promoted to manager, sales engineering division at Philadelphia.

Arthur D. Little, Inc., Cambridge, Mass.—Lewis W. Cabot has been elected a director of Arthur D. Little, Inc., industrial consulting and research firm of Cambridge.

Metron Instrument Co., Denver, Colo.—Ed Pike has been appointed Metron's Eastern District Engineer.

Minneapolis-Honeywell Regulator Co., New York, N. Y.—John E. Boyle has been appointed to the newly created post of director of business planning for the Brown Instruments Div. of Minneapolis-Honeywell Regulator Co.

Scientific Apparatus Makers Assn., Chicago, Ill.—Henry F. Dever, Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Philadelphia, was elected president of the Scientific Apparatus Makers Assn. at the recent annual meeting of the Association. T. M. Mints, president, E. H. Sargent & Co., Chicago, was re-elected treasurer of SAMA.

North American Philips Co., Inc., Mount Vernon, N. Y.—The Research & Control Instruments Div., North American Philips Co. has announced the appointment of Philip I. Wolf as resident sales and application engineer for the western part of the United States with offices at 229 Dwight Road, Burlingame, Calif.

North American Philips Co., Inc., Mount Vernon, N. Y.—Two Norelco X-ray diffraction schools will be sponsored by the Research & Control Instruments Div., North American Philips Co., Inc. The twenty-first week-long series of sessions will be held at the Sir Francis Drake Hotel, San Francisco, from September 26 to 30. The twenty-second series of sessions will be put on at the Hotel Knickerbocker, Chicago, from October 10 to 14.

Nuclear Instrument and Chemical Corp., Chicago 10, Ill.—E. B. Tilton, Chairman of the Board and President of the Nuclear Instrument and Chemical Corp., recently announced the appointment of O. Kenton Neville as Director of the Technical Di-

vision. Prior to his appointment Mr. Neville was Chief of the Chemistry Dept.

Tinius Olsen Testing Machine Co., Willow Grove, Pa.—Tinius Olsen II was elected President of the Tinius Olsen Testing Machine Co., Willow Grove, Pa. Mr. Olsen succeeds his father Thorsten Y. Olsen who was elevated to Chairman of the Board. The new president is the third generation of Olsens to guide this leading testing machine company currently celebrating its 75th Anniversary.

Owens-Illinois Glass Co., Toledo, Ohio—All thermometers and hydrometers manufactured by Kimble Glass Co. will be trademarked EXAX, a name which is reserved for ware that is 100 per cent retested for accuracy before it leaves the factory.

Raycon Corp., Belmont, Calif.—Raycon Corp., manufacturer of high-speed mechanical counters, has moved from its old location in Redwood City into a new building at 248 Harbor Blvd., Belmont, Calif. Turley L. Angle has been appointed assistant general manager.

Robertshaw-Fulton Controls, St. Louis, Mo.—The American Thermometer Div. of Robertshaw-Fulton Controls Co., producer of automatic control devices for home and industry, has been redesignated the American Controls Div.

Robertshaw-Fulton Controls, St. Louis, Mo.—A new warehouse aimed at providing faster delivery service to West Coast customers has been opened by the Fulton Sylphon Div. and Bridgeport Thermostat Div., both units of Robertshaw-Fulton Controls Co., at Lynwood, Calif.

Soiltest, Inc., Chicago, Ill.—Soiltest, Inc., manufacturer and distributor of apparatus for engineering tests of soil, concrete, and asphalt, has moved its manufacturing facilities and offices to a 20,000-sq ft plant at 4711 W. North Ave., Chicago, Ill.

Sprague Electric Co., North Adams, Mass.—Sprague Electric Co. has announced the appointment of Albert H. Postle as sales engineer for ceramic capacitors and printed circuits.

Taylor Instrument Cos., Rochester, N. Y.—On May 1, 1955 the San Francisco offices and plant were moved across San Francisco Bay to 1661 Timothy Drive, San Leandro, Calif. Decision to relocate the plant and sales offices were made on the basis of a greatly increased volume of sales and service activities in the San Francisco area.

NEWS OF LABORATORIES

American Council of Independent Laboratories, Inc., Washington, D. C.—Herbert D. Imrie, President of Abbot A. Hanks, Inc., San Francisco, was elected to the executive committee of the American Council of Independent Laboratories.

Bjorksten Research Labs., Madison, Wis.—A summary of ten years progress and an analysis of plans for the next decade are contained in a report just issued by Bjorksten Research Labs.

California Testing Labs., Inc., Los Angeles, Calif.—After 30 years service to the West, California Testing Labs. has embarked on a new twelve year expansion program, the first step of which has been the acquisition of The California Electronic Services Co., one of the West's leading laboratories in the electronic field.

Charles W. Kettelman, Jr., will continue as secretary-treasurer of the corporation, all personnel and facilities remaining at their present location, 21133 Constanco St., Woodland Hills, Calif.

Other officers include Myron B. Niesley, President, and Philip L. Grimes, Vice-President.

Container Labs., Inc., Chicago 1, Ill.—Opening of a new testing laboratory at 435 Stanford Ave., in Los Angeles.

Industrial Research & Testing Labs., St. Louis 6, Mo.—Allan M. Siegel, Director, has announced the acquisition of larger and modern facilities at 1228 Hadley, St. Louis 6, Mo., a move occasioned by an expansion in both personnel and testing equipment.

Ledoux & Co., Teaneck, N. J.—This laboratory founded in 1880 in New York City and internationally known for its work in weighing samples and analyzing ores and metals from all over the world, is celebrating its 75th anniversary.

Arthur D. Little, Inc., Cambridge, Mass.—Arthur D. Little, Inc., industrial consulting and research firm in Cambridge, Mass., announced today that it has established a new management consulting service for industrial and financial groups interested in atomic energy.

The Pall Filtration Cos., Glen Cove, N. Y.—The Pall Filtration Cos., filtration engineers and producers of porous metals and plastics, have answered the demand for certainty in critical filtration by making available glass head filter calibration services.

Foster D. Snell, Inc., New York 11, N. Y.—The Board of Directors of Foster D. Snell, Inc., consulting chemists and engineers, have elected Philip B. Ostrow, Assistant Secretary.

South Florida Test Service, Miami, Fla.—The South Florida Test Service has opened a new laboratory annex building adjacent to the present main inland proving grounds, laboratory and office buildings. In addition, another test field 275 ft by 275 ft for expanded exposure test facilities is under construction.

United States Steel Corp., New York 6, N. Y.—A mass spectrometer, recently installed at U. S. Steel's Applied Research Laboratory in Pittsburgh, is the first instrument of its kind to be used in the steel industry.

United States Testing Co., Inc., Philadelphia 24, Pa.—United States Testing Co., Inc., has announced the removal of their laboratory to 3925 "M" St., Philadelphia 24, Pa.

CALENDAR OF OTHER SOCIETIES' MEETINGS

August 1-5—**Gordon Research Conferences, A.A.A.S.**, Elastomers, Colby Jr. College, New London, N. H.

August 8-12—**Gordon Research Conferences, A.A.A.S.**, Analytical Chemistry, New Hampton School, New Hampton, N. H.; Statistics in Chemistry and Chemical Engineering, Kimball Union Academy, Meriden, N. H.

August 15-17—**Operations Research Society of America**, Seventh National Meeting, Hotel Statler, Los Angeles, Calif.

August 15-17—**Society of Automotive Engineers**, National Meeting, Golden Anniversary West Coast Mtg., Hotel Multnomah, Portland, Ore.

August 15-19—**Gordon Research Conferences, A.A.A.S.**, Organic Coatings, New Hampton School, New Hampton, N. H.; Glass, Kimball Union Academy, Meriden, N. H.

August 15-19—**American Institute of Electrical Engineers**, Butte, Mont.

August 18-20—**Society of American Military Engineers**, Western Regional Meeting, Seattle, Wash.

August 22-26—**Gordon Research Conferences, A.A.A.S.**, High Pressure Research and Techniques, Kimball Union Academy, Meriden, N. H.

August 22-September 9—**International Wool Textile Research Conference**, Sydney (four days), Geelong (five days), and Melbourne (five days), Australia.

August 29-31—**American Physical Soc.**, Mexico City, Mex.

August 29-September 2—**Gordon Research Conferences, A.A.A.S.**, Adhesion, New Hampton School, New Hampton, N. H.; Fats and Oils, Kimball Union Academy, Meriden, N. H.

August 29-September 2—**International Assn. for Hydraulic Research**, 6th plenary meeting, Delft, Netherlands.

August 31-September 15—**9th International Congress of Refrigeration**, Sorbonne, Paris, France.

September 8-9—**The Fiber Society**, Fall Meeting, Mass. Institute of Technology, Cambridge, Mass.

September 11-16—**ACS**, 128th National Meeting, Minneapolis, Minn.

September 12-15—**SAE**, National Meeting-Golden Anniversary Tractor Meeting and Production Forum, Hotel Schroeder, Milwaukee, Wis.

September 12-16—**Instrument Society of America**, 10th Annual Conference and Exhibit, Shrine Exposition Hall and Auditorium, Los Angeles, Calif.

September 13-15—**American Meteorological Society**, 139th Meeting, Asbury Park, N. J.

September 14-16—**National Petroleum Assn.**, 53rd Annual Meeting, Traymore Hotel, Atlantic City, N. J.

September 15-16—**American Ceramic Society**, Glass, Bedford Springs Hotel, Bedford, Pa.

September 20-22—**Society of Industrial Packaging & Materials Handling Engineers Exposition**, Kingsbridge Armory, New York City.

September 22-25—**American Assn. of Textile Chemists and Colorists**, Annual Convention, Chalfonte-Haddon Hall, Atlantic City, N. J.

September 25-28—**American Institute of Chemical Engineers**, National Meeting, Lake Placid, N. Y.

September 25-28—**ASME Petroleum Conference**, New Orleans, La.

September 28-30—**TAPPI**, Sixth testing conference, Springfield, Mass.

September 29, 30—**Textile Methods and Standards Assn.**, Fall Meeting, Clemson House, Clemson, S. C.

Sept. 29-Oct. 1—**American Ceramic Society**, Materials and Equipment, White Wares, Bedford Springs Hotel, Bedford, Pa.

October 3-5—**Federation of Paint and Varnish Production Clubs**, Annual Meeting and Paint Industries Show, Statler Hotel, New York City.

October 3-7—**AIEE**, fall meeting, Morrison Hotel, Chicago, Ill.

October 4-6—**American Meteorological Society**, 140th Meeting, Stillwater, Okla.

October 5-9—**World Plastics and Trade Exposition**, National Guard Armory in Exposition Park, Los Angeles, Calif.

October 6-8—**Optical Society of America**, Hotel Wm. Penn, Pittsburgh, Pa.

October 7-8—**American Ceramic Society**, Refractories, Bedford Springs Hotel, Bedford, Pa.

October 9-13—**The Electrochemical Society, Inc.**, Wm. Penn Hotel, Pittsburgh, Pa.

October 10-12—**AOCS**, Fall Meeting, Bellevue-Stratford, Philadelphia, Pa.

October 10-12—**ASME-ASLE Second Lubrication Conference**, Antlers Hotel, Indianapolis, Ind.

October 11-15—**SAE National Meeting**, Golden Anniversary Aeronautic Meeting, Aircraft Production Forum, and Aircraft Engineering Display, Hotel Statler, Los Angeles, Calif.

October 14-15—**American Ceramic Society**, Structural Clay Products, Statler Hotel, St. Louis, Mo.

October 16-19—**National Institute of Governmental Purchasing**, 10th Annual Conference and Products Exhibit, Hotel Shoreham, Washington, D. C.

October 17-18—**American Ceramic Society**, Basic Science, Pennsylvania State University, State College, Pa.

October 17-18—**American Coke and Coal Chemicals Institute**, Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va.

October 17-21—**ASM, AWS, AIME, Society for Non-destructive Testing**, 37th National Metal Exposition and Congress, Convention Hall, Philadelphia, Pa.

October 18—**American Society of Safety Engineers**, Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.

October 19-20—**ASME-AIME Joint Fuels Conference**, Neil House, Columbus, Ohio.

October 23-31—**28th International Congress of Industrial Chemistry**, Madrid, Spain.

October 24-26—**ASA and National Bureau of Standards**, Sixth National Conference on Standards, Sheraton Park Hotel, Washington, D. C.

October 24-28—**American Society of Civil Engineers**, Annual Convention, Statler Hotel, New York City.

October 26-28—**American Ceramic Society**, 8th Pacific Coast Regional Meeting, Olympic Hotel, Seattle, Wash.

October 26-28—**Porcelain Enamel Institute**, 24th Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va.

October 27 and 28—**The Quartermaster Assn.**, Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

October 31-November 1—**Operations Research Society of America**, 8th National Meeting, Ottawa, Ont., Canada.

October 31-November 2—**National Lubricating Grease Institute**, Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

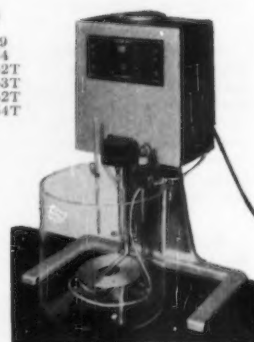
October 31-November 2—**Packaging Institute**, 17th Annual Forum, Hotel Statler, New York City.

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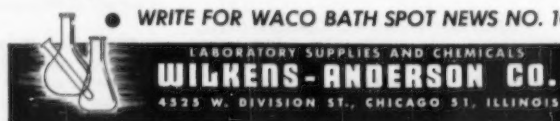


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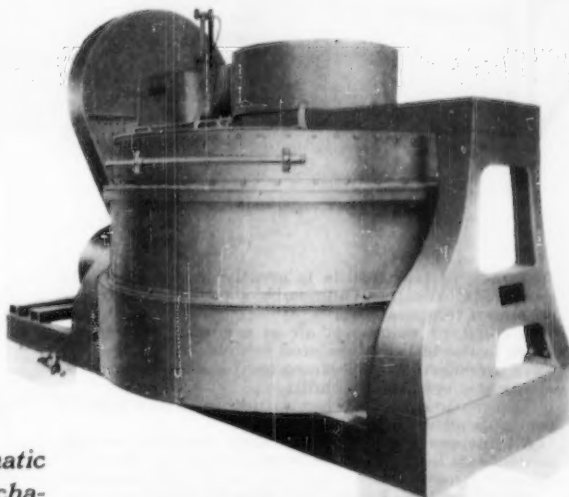
Lancaster's exclusive counter-current "planetary-type" mixing promotes more uniform distribution of solids plus complete dispersion of any liquid additives. The complete batch is turned, divided, brought together by a rubbing-mulling action with each revolution of the pan . . . with pan speed ranging from 6 to 12 revolutions per minute.

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control.

Accuracy in test results is greatly increased in the new DMC Weather-Ometer by a positive control of specimen temperatures.

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